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Copper Roofing

Information for
Architects *and* Roofing Contractors

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COPPER ROOFING

INFORMATION

for

ARCHITECTS

and

ROOFING CONTRACTORS



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SOME FACTS ABOUT COPPER

Copper is the best material for general sheet metal purposes—roofing, eaves troughs, gutters, leaders, flashings, ridge rolls, ridge caps, leader heads, cornices, etc.

Its physical and chemical characteristics make it the outstanding metal for long service under severe conditions.

Because there are no appreciable maintenance costs its service value increases with age.

DURABILITY:

A roof of pure sheet copper will last for generations, possibly for centuries. Numerous important buildings, as well as many fine residences, in the United States have copper roofs over 100 years old; in Europe and Asia are countless examples which have lasted for centuries.

Copper retards appreciably the corrosive action of acid fumes, and is a most effective material for use under extreme atmospheric conditions such as are found in manufacturing localities and cities. Even near the sea coast its durability is unquestioned.

APPEARANCE:

The green carbonate coating which appears on copper after exposure to the atmosphere not only acts as a shield against deterioration, but also makes it the most beautiful of all roofing materials.

Other color effects can be produced and can be made permanent. Wherever used on a building copper adds beauty, dignity and character.

WEIGHT:

The non-corrosive properties of copper make it possible to use a thin sheet and its comparative lightness permits its use in construction work without the necessity of heavy supporting structures.

The weights of various roofing materials per square (100 square feet) on the roof are as follows:

Material	Weight for 100 sq. ft. Laid
Shingle Tile	1200-1800 lbs.
Spanish "	650-850 "
Slate	450-675 "
Felt and Gravel (or Slag)	400-625 "
Asbestos Shingles	300-650 "
Hardlead Sheets	210-325 "
Wood Shingles	200-300 "
20 g. Galv. Iron (Corrugated)	225 "
16 oz. Copper (Standing Seam)	125 "
Copper Shingles	84-100 "
Tin	75 "

MALLEABILITY:

Copper is one of the most ductile of metals. No other is more easily worked or so permanent when formed. It may be spun, stamped, rolled, hammered, hot or cold, or worked by almost any known process. This is a decided

advantage in working with copper, as the "brittleness" which renders other metals difficult to handle is not present.

SALVAGE VALUE:

Copper has a higher salvage value than any other metal used for building purposes. Being indestructible, it can be salvaged from any building destroyed and will always sell for a reasonable figure.

ECONOMY:

Freedom from repairs or maintenance expense, combined with durability and absolute protection against the weather under all conditions, makes copper the most economical as well as the best roofing material obtainable. It does not require painting or special protective treatment of any kind. First cost is the only expense involved in the use of copper for building purposes.

COPPER ROOFS

The observance of certain fundamentals in applying any and all kinds of materials is essential, but because of the more frequent use of one material, the characteristics thereof are frequently assumed to be standard for all. To correct this it becomes necessary to emphasize certain properties of copper which differ from those of iron, steel, zinc and lead. Copper has a higher coefficient of expansion than iron or steel; a lower one than zinc or lead. In all other respects the good workmanship used in applying any form of metallic roofing is all that is necessary to insure the enduring properties of copper.

In a variation of 150 degrees of temperature the expansion and contraction of copper is a scant 3/16 of an inch in 10 feet. The skilled roofer easily takes care of this physical property of copper in three ways, namely: (1) by transferring the stress from the sheet itself to a cleat used to hold the sheet in place, or by means of (2) the standing seam or (3) the expansion joint.

SLOPING ROOFS

There are two methods of applying copper sheets to sloping roofs, viz: the Ribbed Seam method; and the Standing Seam method.

RIBBED SEAM METHOD

[Illustrated on Sheet 1]

The proper size and spacing of the battens is dependent upon the type of structure and the scheme of decoration. They are about 2 inches square in section, with sides beveled about 1/8 inch, firmly secured to the roof sheathing.

Soft (roofing temper) copper sheets of required width (20 or 30 inches) and standard length of 96 inches, tinned on the crosswise edges, are laid on the roof; with a forming tool the edges of the long dimensions are turned up at right angles to the sheet and are again turned at the top of the vertical leg parallel to and toward the sheet.

These soft copper sheets so formed, staggered with adjoining sheets, are

securely held in place by copper cleats, spaced at intervals of 8 inches and firmly attached to the top and sides of the batten or wood rib by copper nails, the free ends of the cleats being turned over to engage the edges of the sheet on its long dimension formed as above described.

The batten or wood rib is then covered with copper sheet of the required width, the edges of which engage the edges of the sheets and the cleats, a locked joint resulting. At the crosswise joints these copper sheets are held firmly in place by use of the locked seam, soldered together in a positive union, as in any other form of metallic roofing of this description.

On steep slopes where conditions will warrant, it is possible to avoid the expense of tinning the sheets and soldering the cross seams by taking care to lock the joint by hammering it flat.

STANDING SEAM METHOD

[Illustrated on Sheet 2]

Vertical bends are made with forming tools on the lengthwise edges of

the sheets—that on one side being $1\frac{1}{2}$ inch and that on the other being $1\frac{1}{4}$ inch, a $1\frac{1}{2}$ inch vertical bend always adjoining one of $1\frac{1}{4}$ inch. Copper cleats, firmly attached to the roofing boards beneath the edge having a $1\frac{1}{2}$ inch vertical, then engage the verticals, which are locked together as in Fig. 3. The seam so formed is then flattened to a slight degree and is again turned over, forming a double lock.

The crosswise edges are well tinned, locked, and sweated full of solder.

On very steep roofs the tinning and soldering of the cross seams, where well away from vertical projections, may be omitted.

The standing seam allows lateral expansion and contraction in the space between the two vertical sections above the plane of the roof and below the double locked seam.

In both the ribbed and standing seam form of roof, the edges of the copper roof at the side walls are placed under the flashing, and in no case are secured to roof timbers or to the side walls.

FLAT COPPER ROOFS

[Illustrated on Sheet 3]

Using a sheet 10" x 14" or 14" x 20", the Roofing Contractor either has the sheets tinned on all edges by the manufacturer or tins them on the job, then forms them as required to engage $\frac{1}{2}$ inch bends on adjacent sheets; the top and one side have bends over the sheet, while the bottom and the other side are under. Each sheet is held firmly in place by copper cleats. The sheets are then soldered together (Fig. 1).

As no nails are driven thru the sheets, they are free to move and all stress from expansion is taken up by the cleats. This stress is scarcely appreciable in any one cleat, and as the cleats are uniformly distributed over the roof, expansion is amply provided for. On large areas it is sometimes advisable to use a standing seam to take care of expansion.

SOLDERING

All soldered seams should be made in precisely the same manner as in other forms of metallic roofing, using the standard fifty-fifty solder with a flux of resin. A heavy type of solder-

ing iron should be used and greatest care exercised to obtain a thoroughly sweated joint.

PAPER UNDER COPPER ROOFING

What material, if any, shall be placed over the sheathing, is a matter for the Architect to decide. Local conditions are a ruling factor in this matter. If used, good practice requires either the ordinary building paper or a resin-sized or asbestos paper of the greatest obtainable widths in order to do away with all nailings possible. None but copper nails should be used.

ROOFING BOARDS OR SHEATHING

Care should be exercised by the Architect in selecting this material. It is recommended that narrow tongue-and-groove roofing boards be used. All roof sheathing should be well laid with close joints and secured at all bearings with heavy nails well set.

Immediately after laying, the sheathing should be protected by covering it with waterproof paper or felt.

THICKNESS OF COPPER SHEETS FOR ROOFS

The thickness of metal required for a durable copper roof should be determined by the Architect, who best knows the conditions to be met. It is not fair to a good material to use too thin a sheet. As copper does not corrode, there is no question of durability in the thinner gauges. However, there must be considered the matter of extraneous damage. Copper sheet weighing one pound per square foot, commonly known as 16 oz. copper, has been considered the standard sheet sufficiently strong to withstand extraneous injury.

The use of 16 oz. material is consistent with good practice and insures a satisfactory roof.

FUNDAMENTALS IN SHEET COPPER ROOF CONSTRUCTION

There are a few fundamental requisites in applying a sheet copper roof, the observance of which cannot be over emphasized.

For all types of roof described in the foregoing text use soft (roofing temper) copper sheets only.

In general soft copper will give the most satisfactory results, though hard (cornice temper) sheets are sometimes used. The soft sheet is, as can readily be understood, more easily workable, especially for flashings where bends, etc., are necessary.

Never drive a nail thru a copper sheet. Always secure the copper sheet in position by means of copper cleats, the cleats only being nailed to the roofing boards, the battens or wood ribs. Never use nails of iron or steel to fasten copper at any place or under any circumstances.

If possible, never use copper in contact with another metal, but if the plan of construction requires the use of iron or steel, by all means see that the iron or steel device is heavily tinned or that sheet lead is inserted between the copper and the other metal. The use of brass devices is recommended.

Nails holding the roofing boards in position should be well set before copper is applied.

The temperature at the time the work is done must be taken into consideration by the contractor in allow-

ing for expansion and contraction. A roof laid in July needs little room for expansion, as it is being laid in a high temperature. It does, however, require ample provision for the contraction which comes with cold weather. The reverse is, of course, true when a roof is laid in cold weather, and under these circumstances the contractor must be particularly careful to provide ample room for expansion.

As soon as a portion of the roof is finished it should be carefully cleaned of all flux, scraps and dirt.

FLASHINGS

All flashings should be of copper.

When preparing plans and specifications which include special cases of flashing, such as deep pockets where snow is liable to collect two or three feet deep with consequent melting and freezing, these should be specially detailed.

The accompanying drawings show several of the usual types of flashings, and the specification is written to cover these circumstances only.

GUTTERS AND EAVES TROUGH

On the four drawings are shown construction details for moulded hanging gutters, eaves trough, and gutter linings. The method of finishing the sheets at the gutter edge or eaves is also shown. Fig. 5, Plate 1, shows the method of finishing the sheet for ribbed and standing seam roofing used with gutter linings. The method used with flat seam roofing is shown on Plate 3, Figs. 2 and 3. In moulded hanging gutter and eaves trough construction there are several good methods in use which differ chiefly in the type of hanger and the manner of finishing the sheets at the edge. Fig. 5, Plate 1, show methods of finishing the battens at the edge or eaves, and Figs. 6 to 10, Plate 4, show various types of gutters and the method of securing them and finishing the sheets.

COPPER SHINGLES

Another form of copper roof covering is copper shingles. These are made from hard rolled copper sheets in a variety of sizes and designs. The method of application is simple. They are secured to the roof sheathing by

copper nails on the top. Each shingle laps over the adjoining ones in such manner as to form a water-tight joint. No soldering is required. No allowance for expansion is necessary as the form of the shingle provides ample room for movement.

Copper shingles can be laid equally well on new roofs and over old shingled roofs. Because of their raised-butt construction they are lifted slightly, thus providing an air space between the shingle and the roof sheathing, allowing ample ventilation with consequent coolness in summer.

Copper shingles are light. A roof so covered weighs only one-ninth as much as slate and one-third as much

as wood. This feature means a real economy in structural framing.

DECORATIVE EFFECTS

Copper has a peculiar advantage over other metals used for roofing in that it contains in itself all the requirements of decoration. It can be oiled and left to mellow to that dull bronze color so typical of roofs of character and quality, or it can be treated with different chemicals to bring out various attractive shades of green and blue.

Near salt water, copper roofs can be used with the assurance that they will gradually assume a soft green color, giving to the house dignity and beauty.

COPPER ROOFING—A CONDENSED SPECIFICATION

(Note: The paragraphs have been numbered for the convenience of specification-writers.)

GENERAL

1. Where shown on the drawings and described elsewhere and below in the specifications all sheet metal work and roofing, including copper roofs, flashings, gutter linings, eaves troughs, leaders, leader heads, skylights, and all other work of like class or incidental to the above listed work necessary for its proper completion, shall be best grade copper sheet of size and weight as called for.

All materials shall be plainly marked with manufacturer's label and weight.

SOFT (ROOFING TEMPER) COPPER

2. All copper throughout the work, except as specified below, shall be of 16 oz. soft (roofing temper) copper sheets.

HARD (CORNICE TEMPER) COPPER

3. All hanging gutters, leaders and cornices as specified below shall be of 16 oz. hard (cornice temper) copper sheets.

SOLDER

4. All solder shall be of the best grade and shall be composed of one half pig lead and one half block tin (new metals).

FLUX

5. Resin shall be used as a flux.

**NAILS AND
FASTENINGS**

6. All nails used throughout the work shall be of best grade hard copper. Under no conditions shall other kinds of nails be used.

All sheets shall be secured by means of copper cleats, $1\frac{1}{2}$ " x 3", which shall be fastened to the sheathing boards by two copper nails $\frac{7}{8}$ inches long. The ends of the cleats shall be turned back over the nails.

PRECAUTIONS

7. Where copper sheets are being laid on a roof or deck the contractor shall display prominent signs warning against unnecessary walking thereon. Under no circumstances shall metal-edged implements be used to clean a roof.

GUARANTEE

8. The contractor shall give to the owner a written guarantee which shall specify the kind, weight and manufacturer of the materials used and shall guarantee all workmanship against failure for a period of years after the acceptance of the work.

**SHEATHING
WOOD**

9. Before applying copper to any surface this contractor shall see that same is properly sheathed with thoroughly seasoned lumber laid close and well nailed, nails set. All uneven edges of boards shall be smoothed off to give a firm even surface.

[Note: Under carpenter specification provision should be made for properly preparing the sheathing for placing copper.]

PAPER

10. Before laying copper over wood sheathing cover all surfaces with building paper of approved quality felt, resin-sized, or asbestos. Paper shall be as wide as possible. All paper shall be secured with copper nails.

FINISH

11. After roof is complete all joints shall be carefully tested for leaks. All surplus resin shall be carefully removed and the whole surface be carefully swept and left in first class condition.

**RIBBED SEAM
ROOF**

12. All wood ribs shall be placed under another contract. The roofing contractor shall see that these are well secured with all nails well set, truly lined and evenly spaced, and shall not proceed until all faults have been corrected.

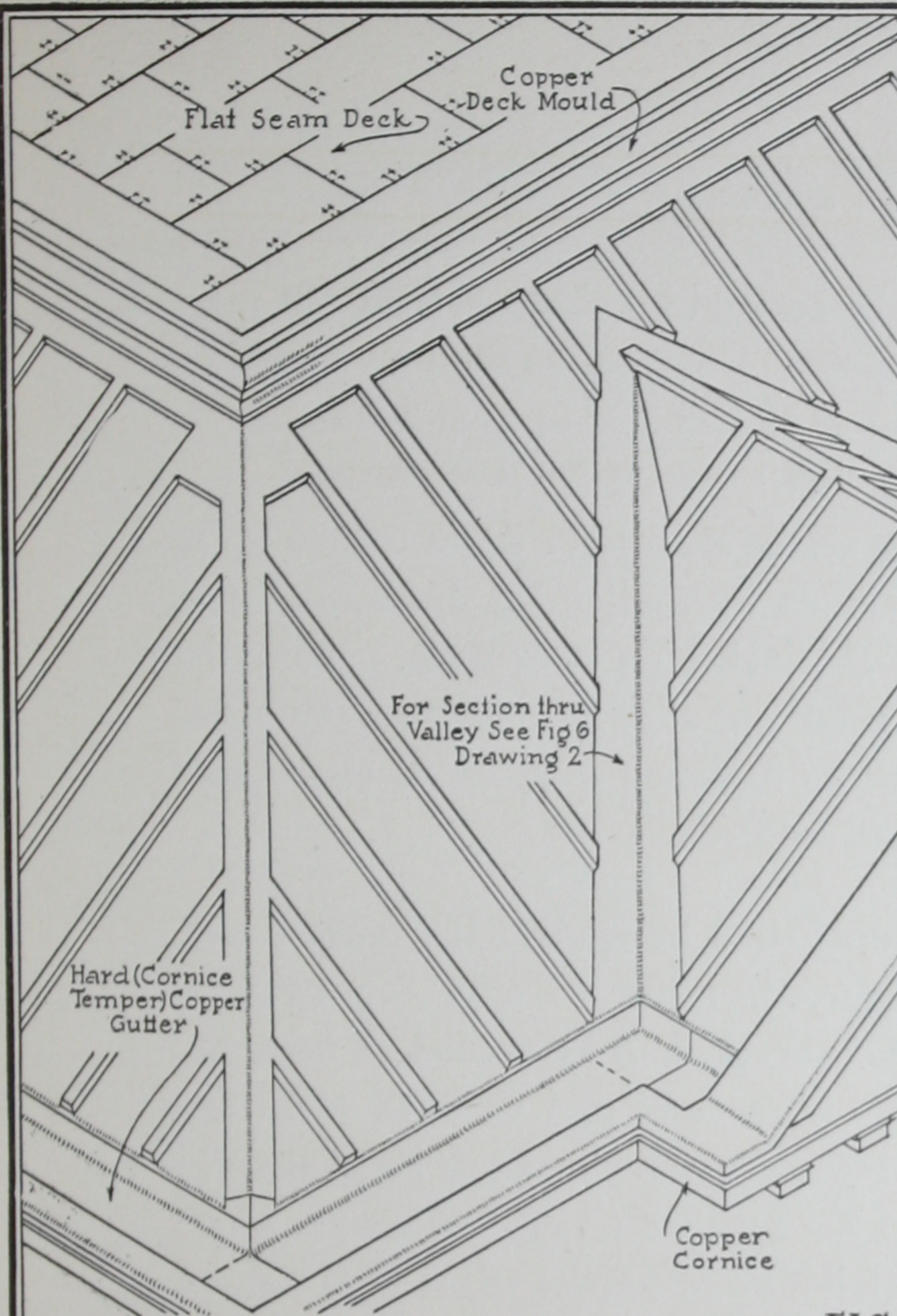
The sheets shall be 20 or 30 inches wide and 96 inches long. They shall be fastened by $1\frac{1}{2}$ " x 3" cleats spaced 8 inches apart and secured alternately to the top and side of the batten. The cleats shall be locked to the sheet and the battens shall be covered with a flashing cap locked over the cleats and edges of sheets on both sides.

All cross seams shall be tinned $1\frac{1}{2}$ inches on both sides, locked and thoroughly sweated with solder.

**STANDING
SEAM ROOF**

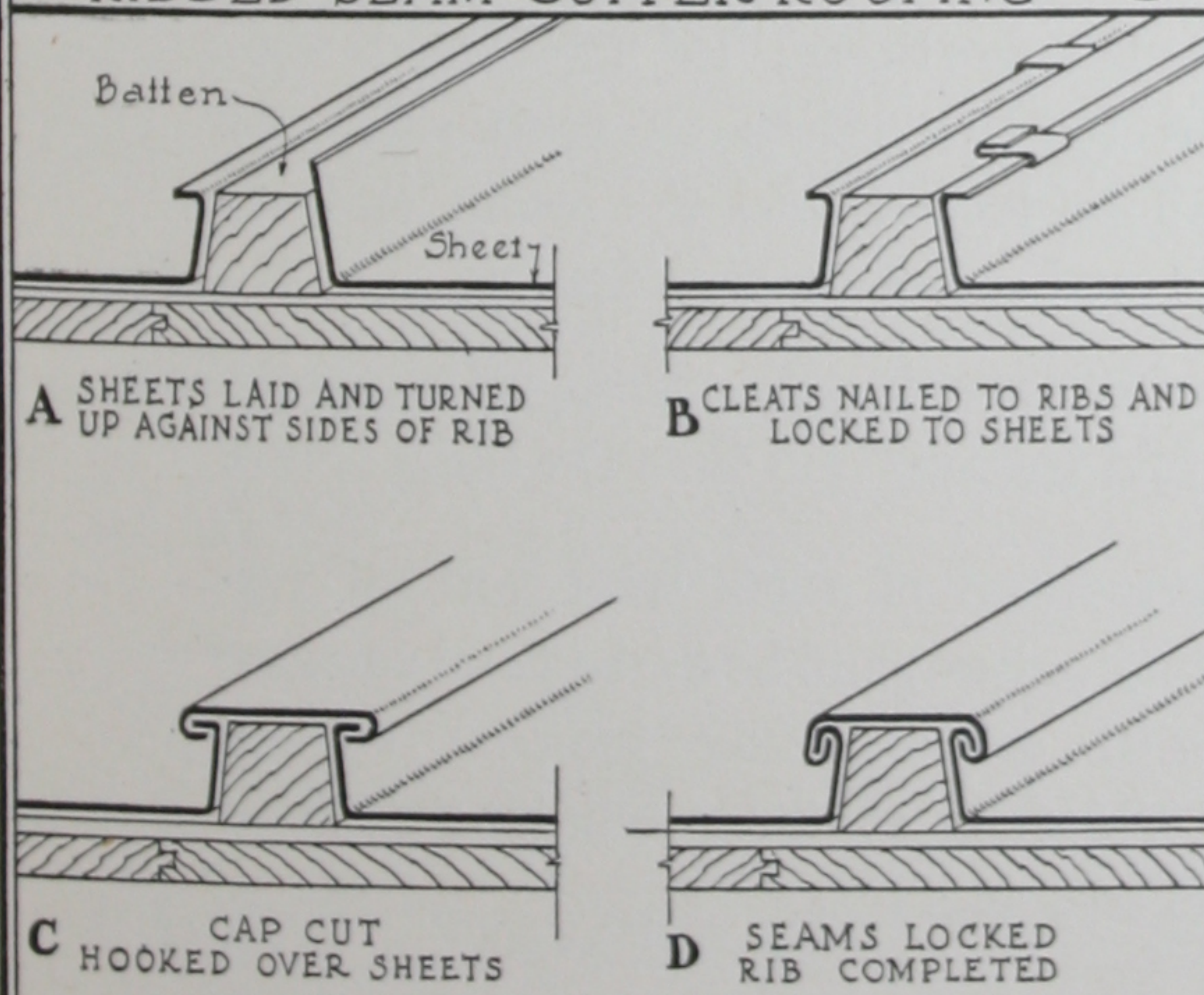
13. All sheets shall be 20 or 30 inches wide and 96 inches long.

All sheets shall be laid with long edges turned up $1\frac{1}{4}$ inches on one side and $1\frac{1}{2}$ on the other



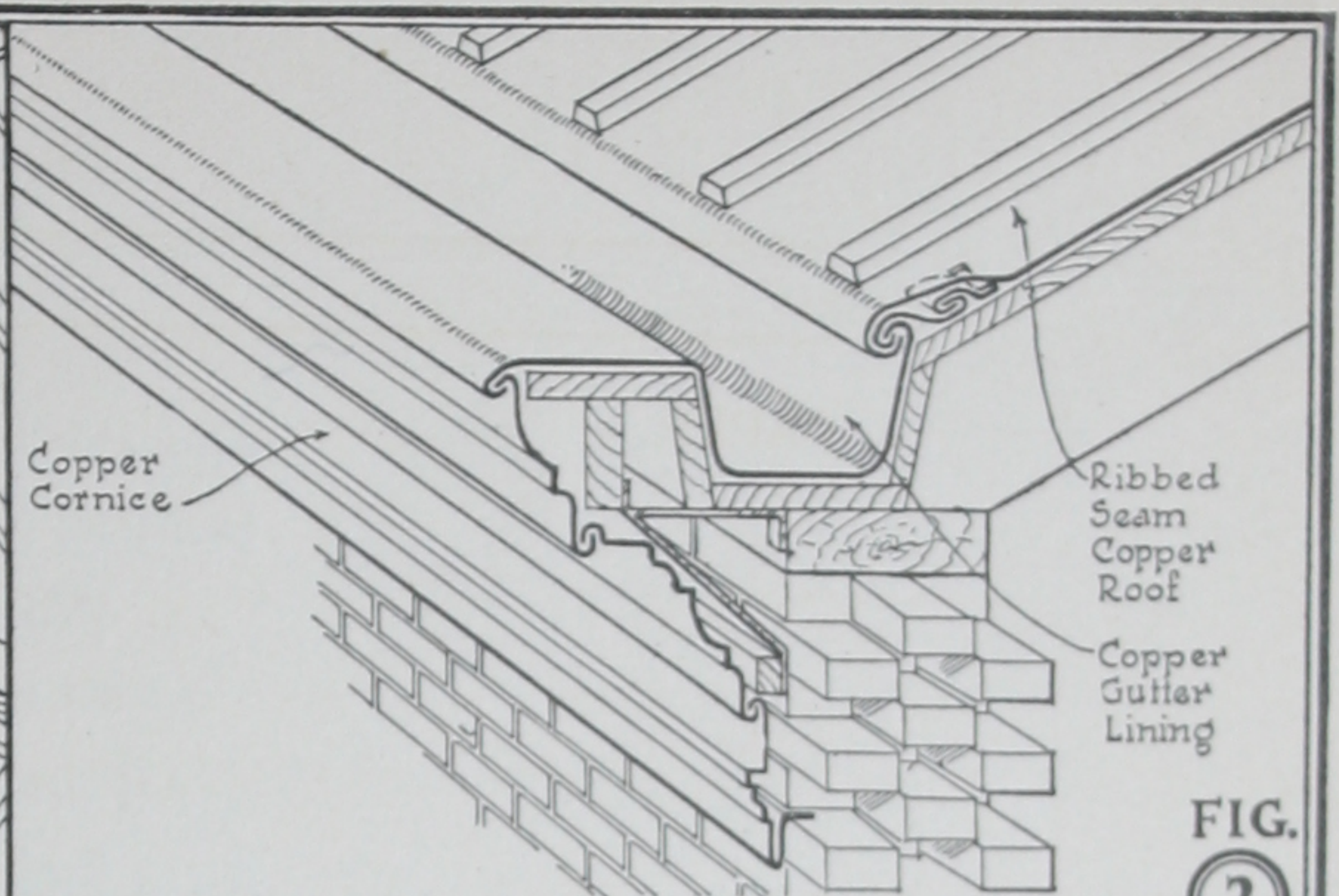
DETAIL SHOWING APPLICATION OF RIBBED SEAM COPPER ROOFING

FIG. 1



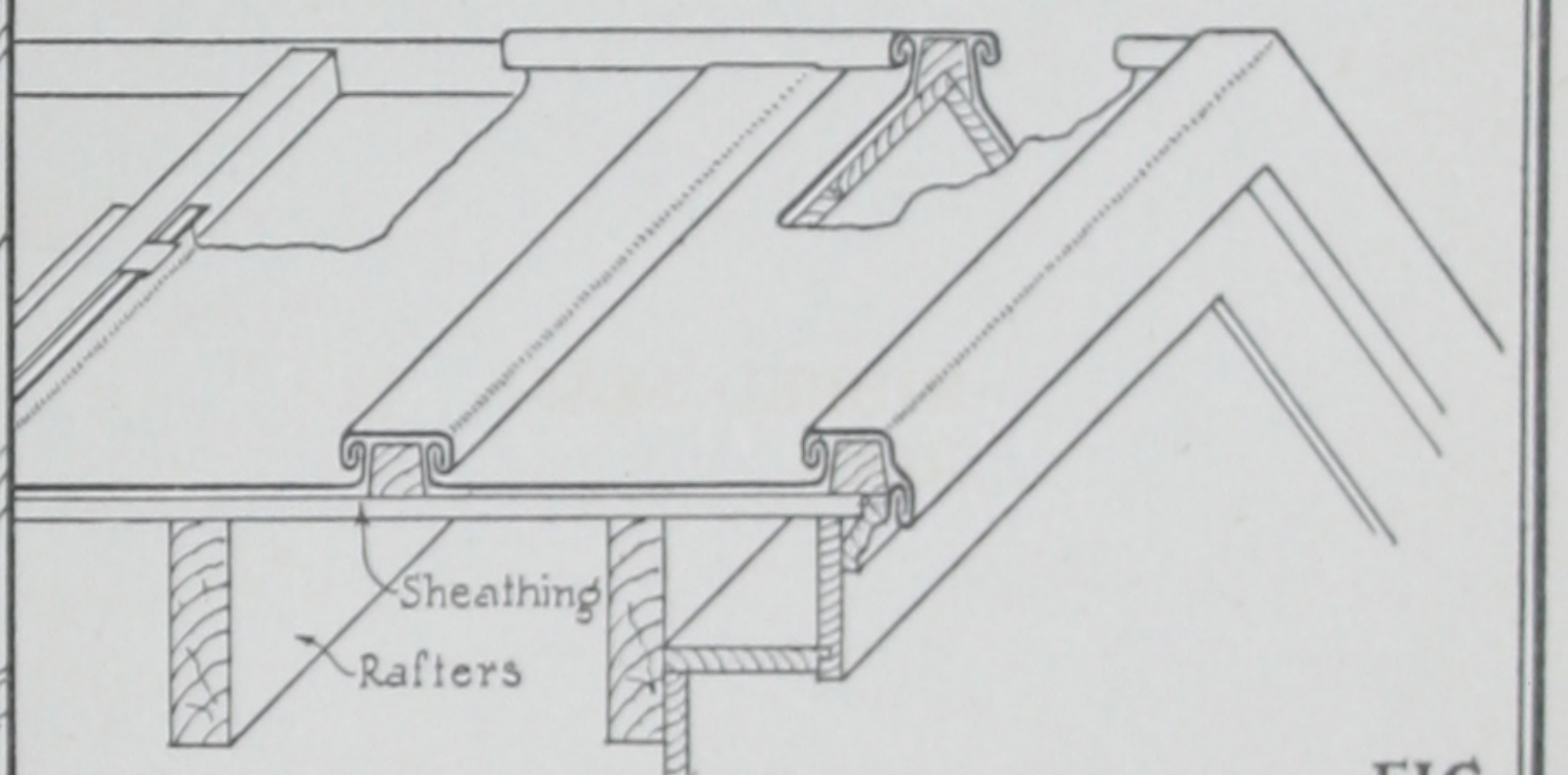
STEPS IN LAYING RIBBED SEAM COPPER ROOFING

FIG. 4



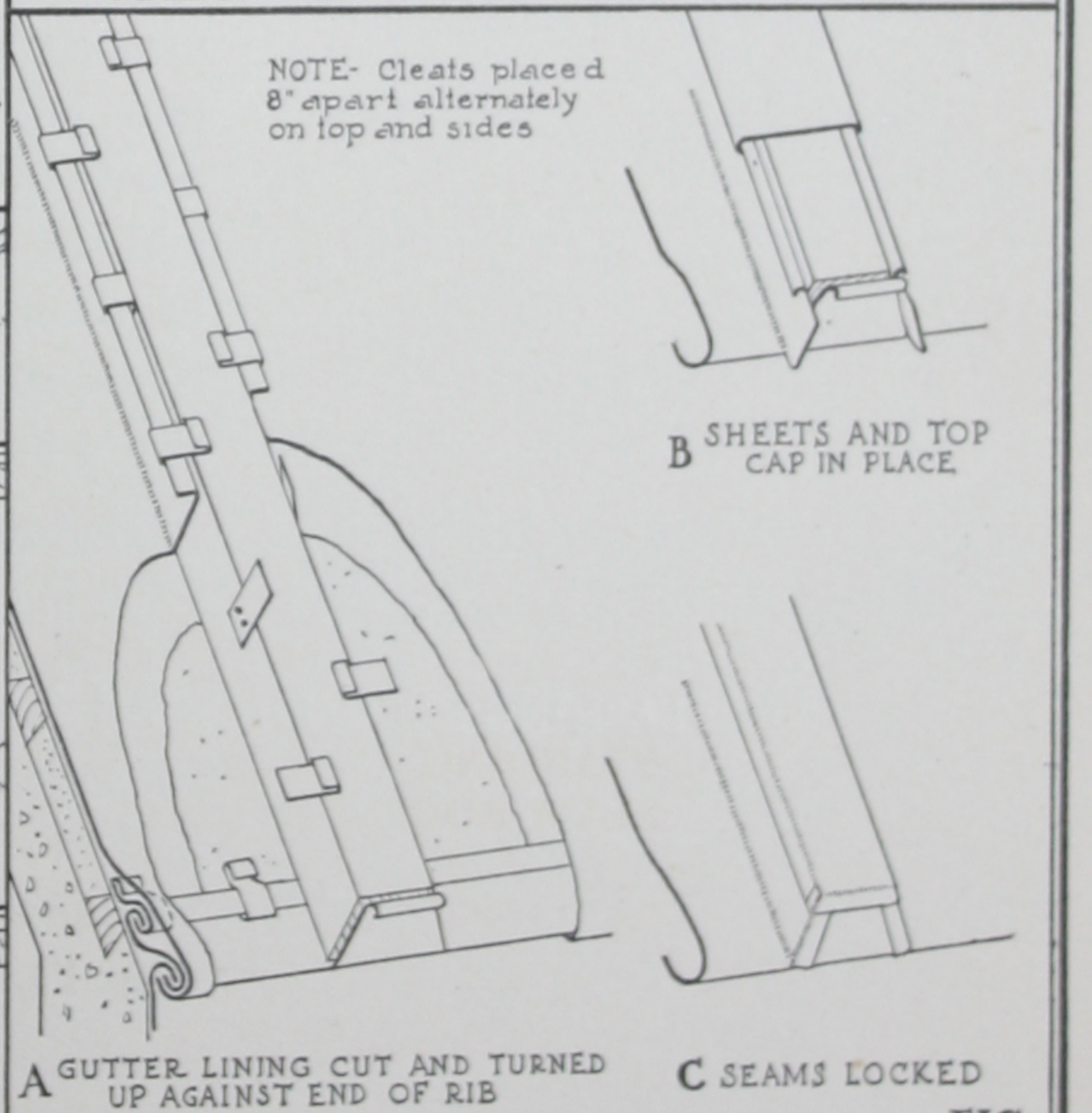
RIBBED SEAM ROOF WITH COPPER CORNICE

FIG. 2



METHOD OF FINISHING ROOF AT GABLE END AND RIDGE

FIG. 3



METHOD OF FINISHING ENDS OF RIBS

FIG. 5

and shall be secured by cleats spaced not more than 12 inches. Cross seams shall be staggered.

[Note: If $\frac{3}{4}$ inch finished seam is specified, turn up edges 1 and $1\frac{1}{4}$ inches respectively.]

All cross seams shall have edges turned up to form lock joints with adjoining sheets, and shall be tinned $1\frac{1}{2}$ inches on both sides. No solder shall be used on standing seams. All cross seams shall be flattened as specified above, and shall be well soldered.

FLAT SEAM ROOF

14. The roofing shall be applied the narrow way, joints staggered, using 10" x 14" or 14" x 20" sheets. All sheets shall be tinned at least $1\frac{1}{2}$ inches wide all around and on both sides, and shall be properly notched. Each sheet shall be secured to the roof with $1\frac{1}{2}$ " x 3" copper cleats evenly distributed along the edges of the sheet, and fastened as specified above. 10" x 14" sheets shall be secured by two cleats on the long and one on the short side; 14" x 20" sheets shall be secured by two cleats on each side. All cleats shall be locked into the seams and the sheets flattened smooth with a mallet.

Thoroughly sweat all seams with solder, soldering first the long and then the short seams.

FLASHINGS

15. All intersections of roofs with vertical surfaces of every nature shall be flashed and counter-flashed with soft (roofing temper) copper. Flashings generally shall be full length pieces locked and soldered.

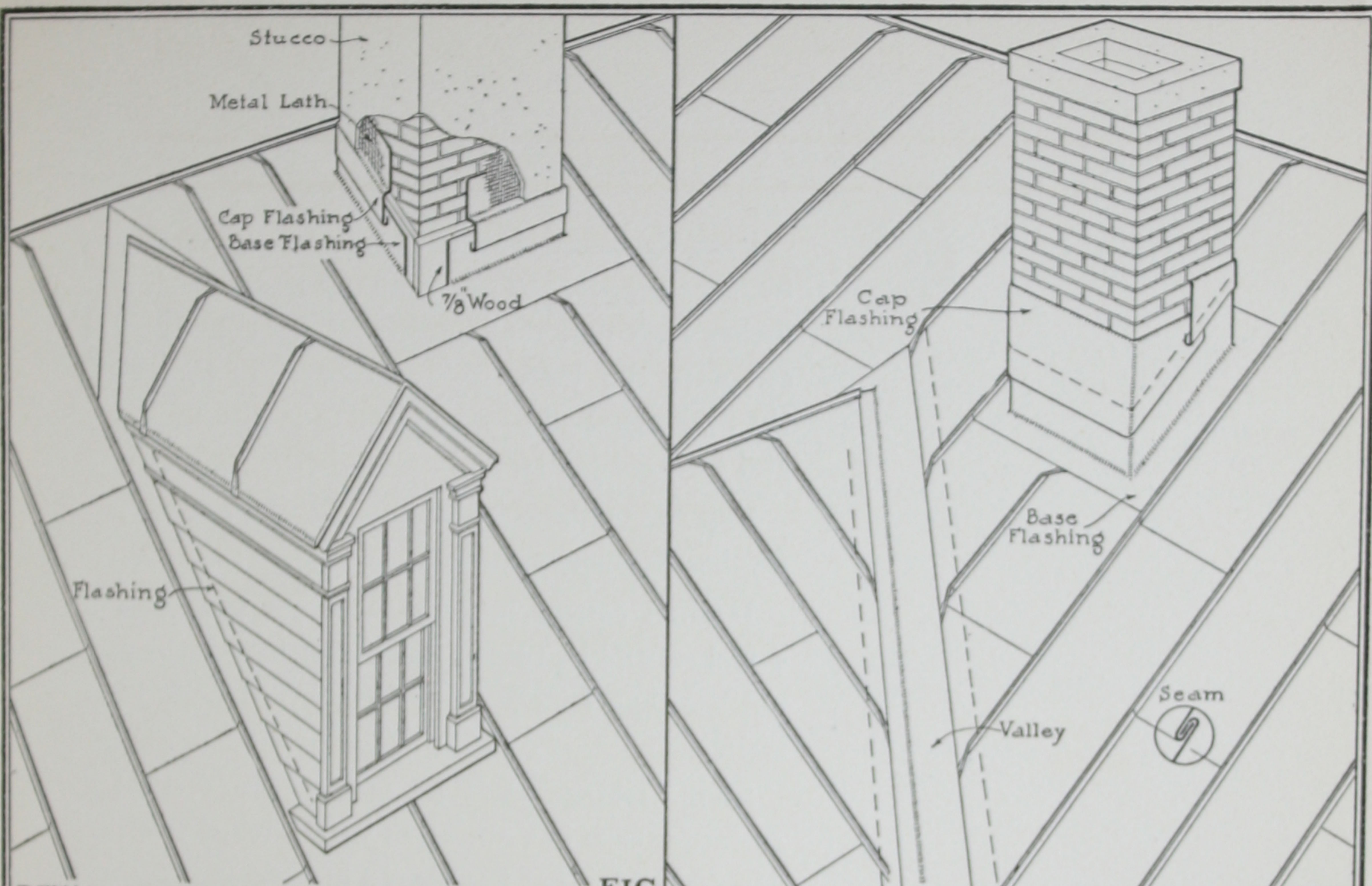


FIG. 1 DETAIL SHOWING METHOD OF FLASHING AROUND DORMER AND STUCCO CHIMNEY

FIG. 2 DETAIL SHOWING METHOD OF FLASHING AROUND VALLEY AND BRICK CHIMNEY

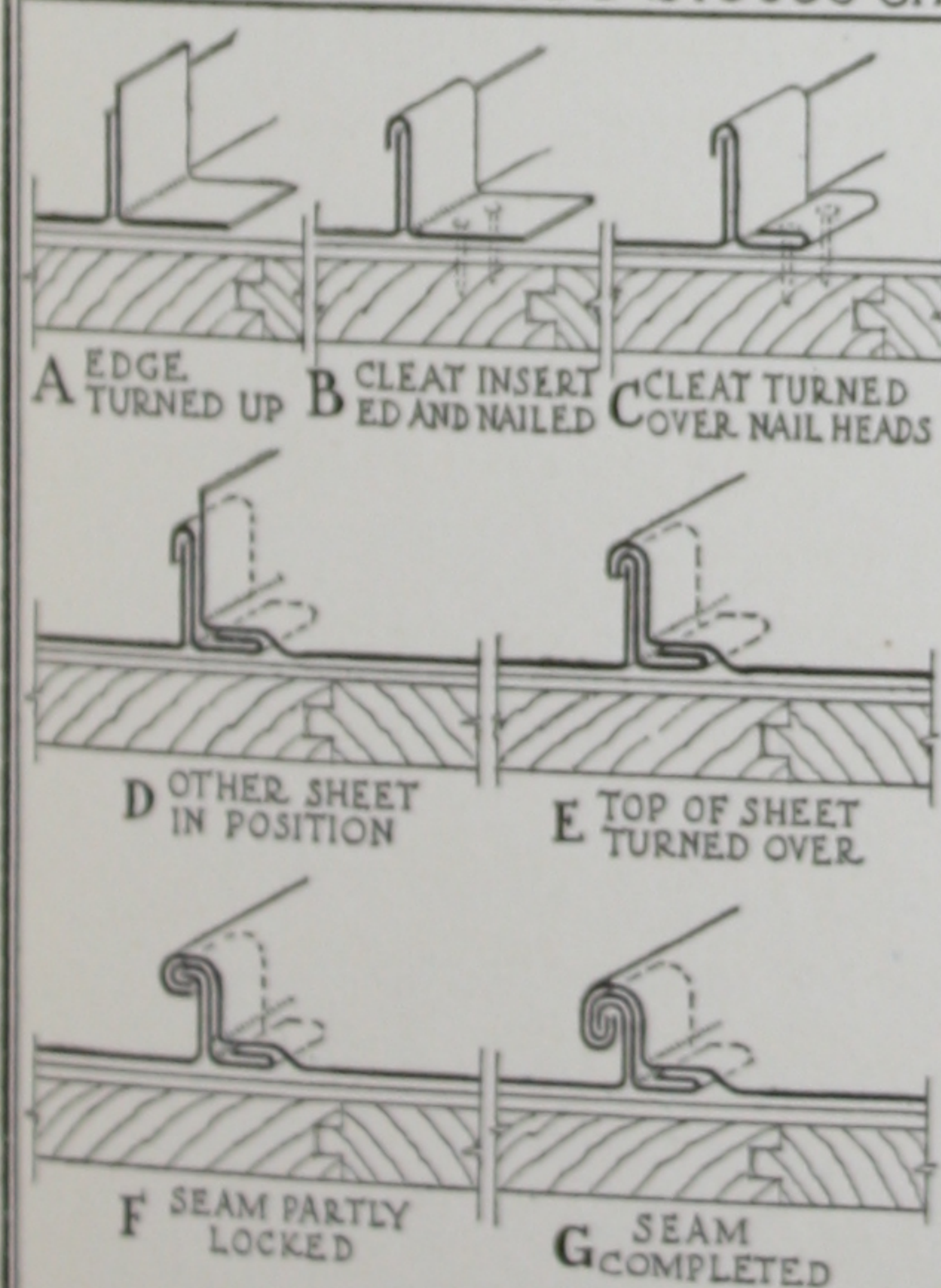


FIG. 3 STEPS IN LAYING A STANDING SEAM COPPER ROOF

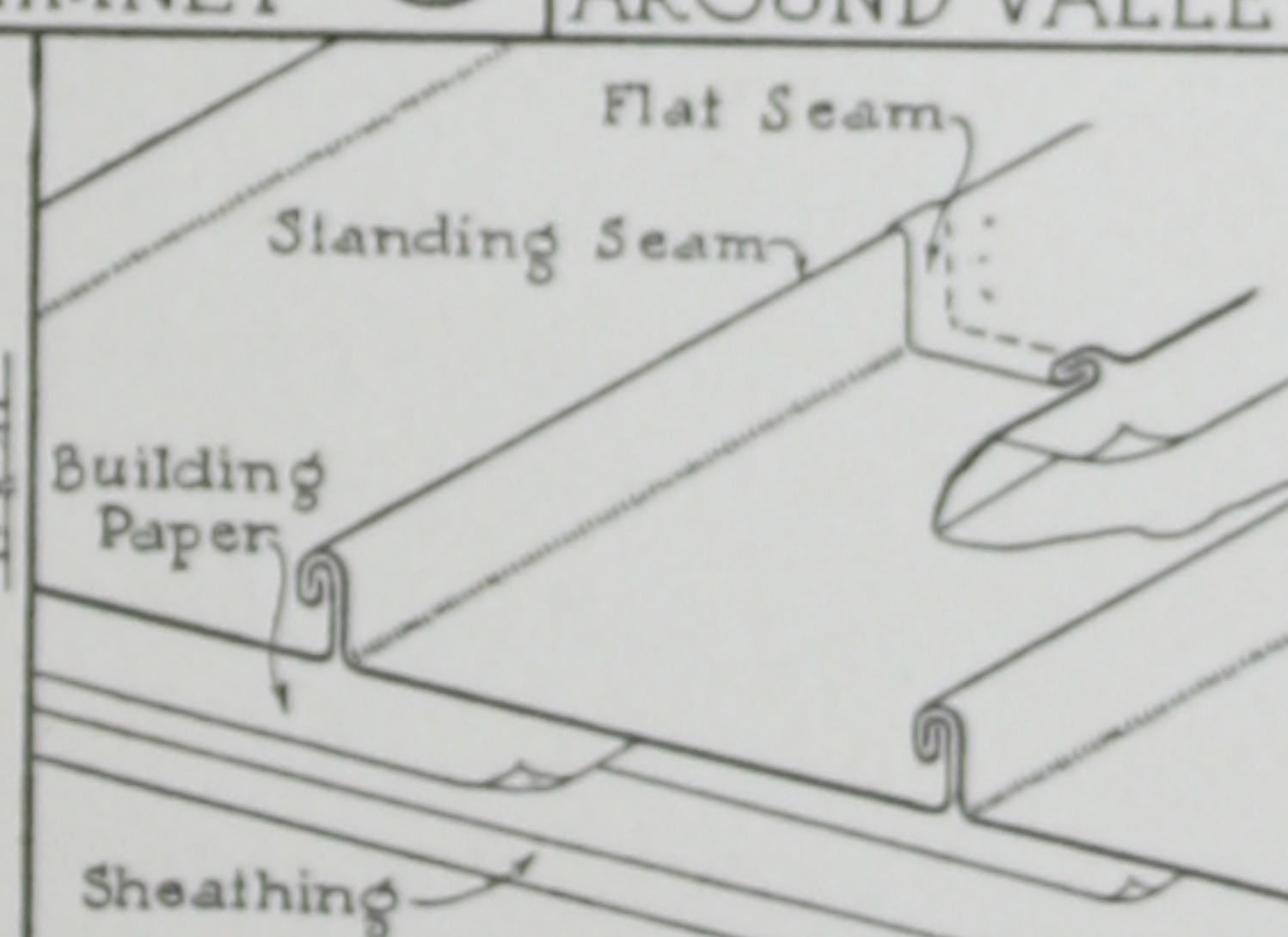


FIG. 4 DETAIL SHOWING SPACING OF SEAMS

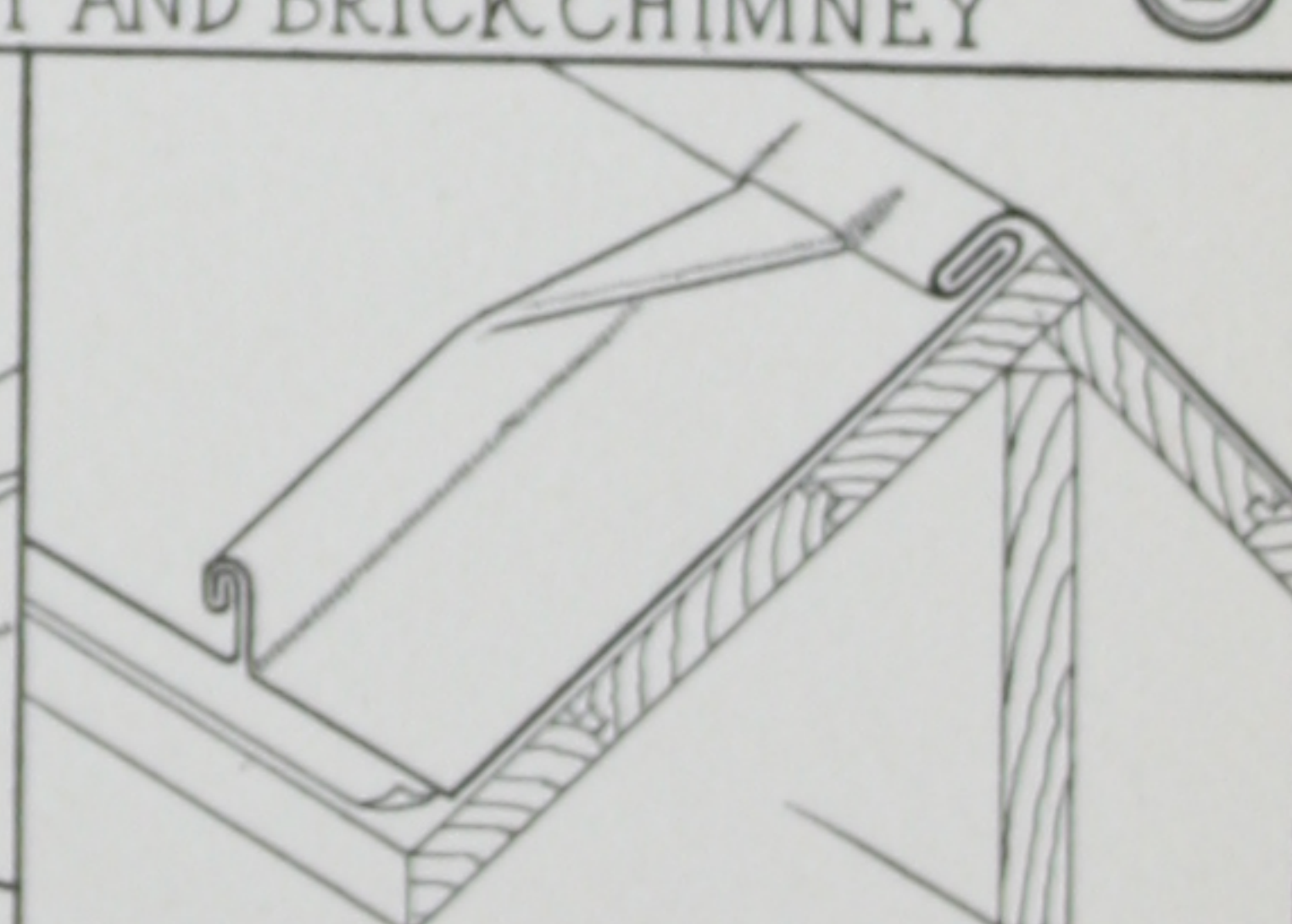


FIG. 5 DETAIL SHOWING STANDING AND FLAT SEAM AT RIDGE

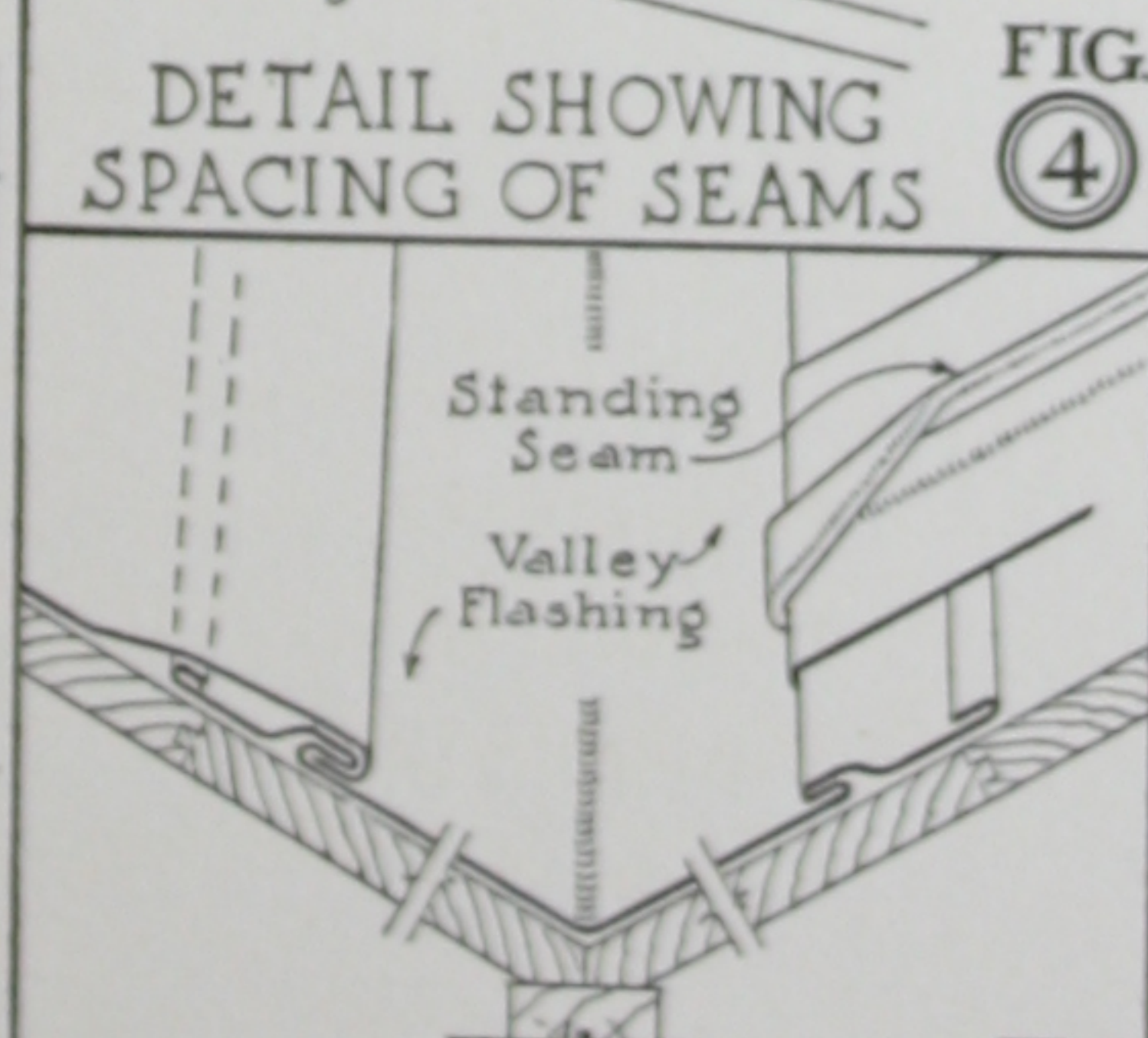


FIG. 6 DETAIL SHOWING STANDING SEAM AT VALLEY

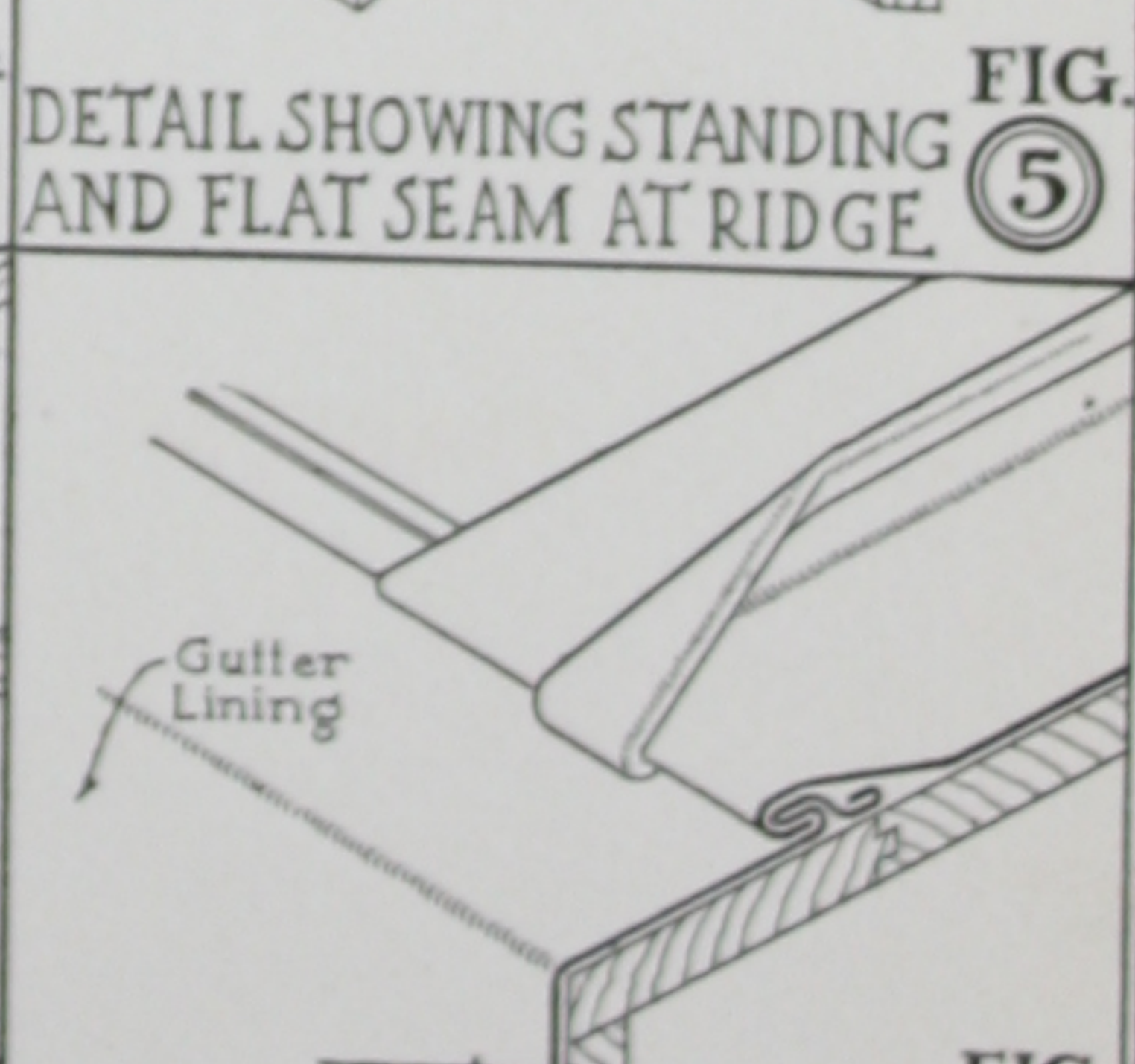


FIG. 7 DETAIL SHOWING STANDING SEAM AT GUTTER

NOTE-ALL SEAMS HAVE BEEN EXAGGERATED TO SHOW CLEARLY METHOD OF LAYING

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DETAILS OF STANDING SEAM COPPER ROOFING

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Base flashings shall be 16 oz. soft (roofing temper) copper. They shall not be less than 8 inches high and shall project at least 4 inches out onto the roof. Where roof is of copper, the flashings shall be connected to it with locked and soldered joints.

Cap or counter-flashing shall be of 16 oz. soft (roofing temper) copper.

It shall extend into the wall not less than 4 inches, and be turned down over base flashing not less than 4 inches and edge turned back $\frac{1}{2}$ inch.

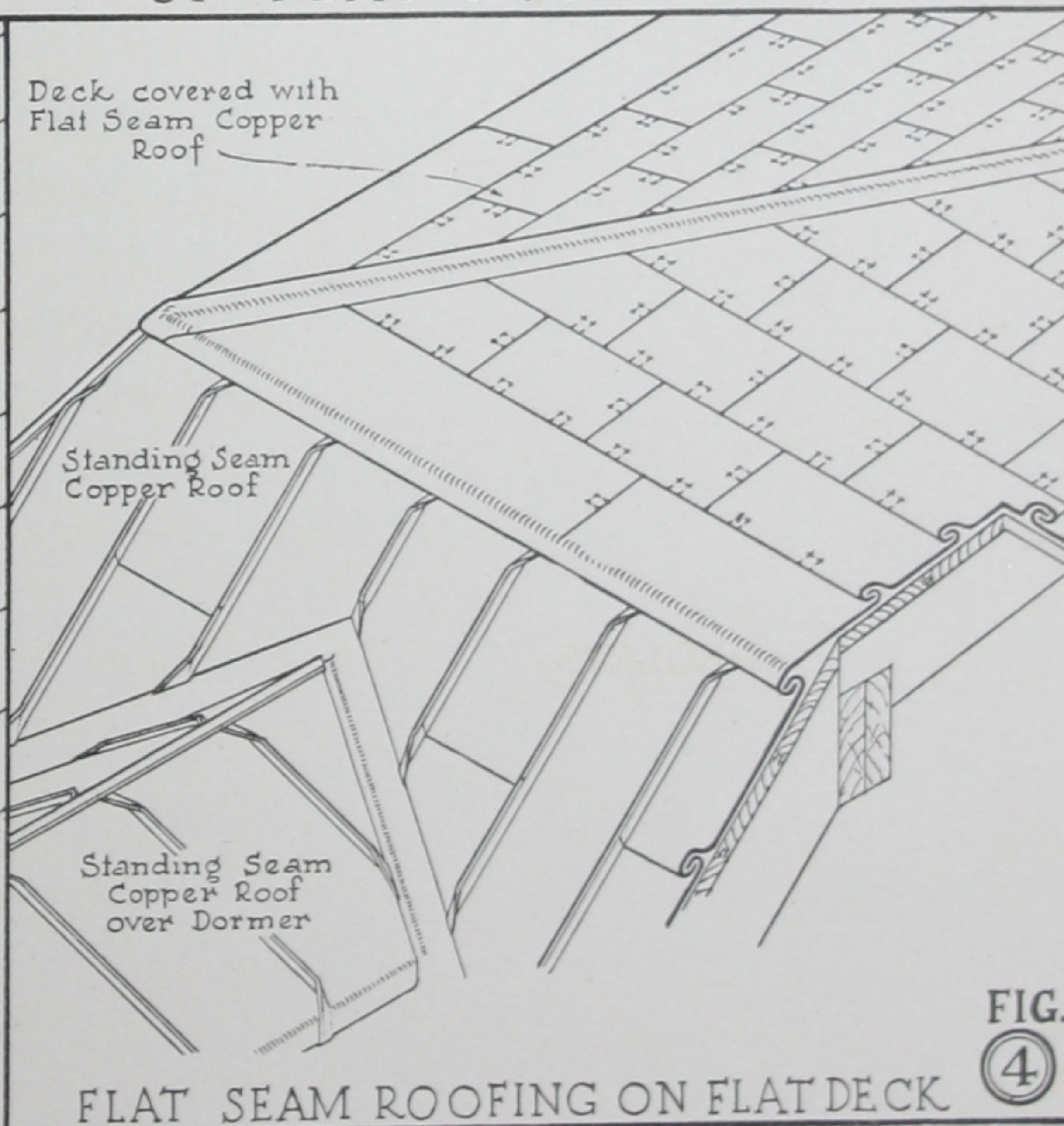
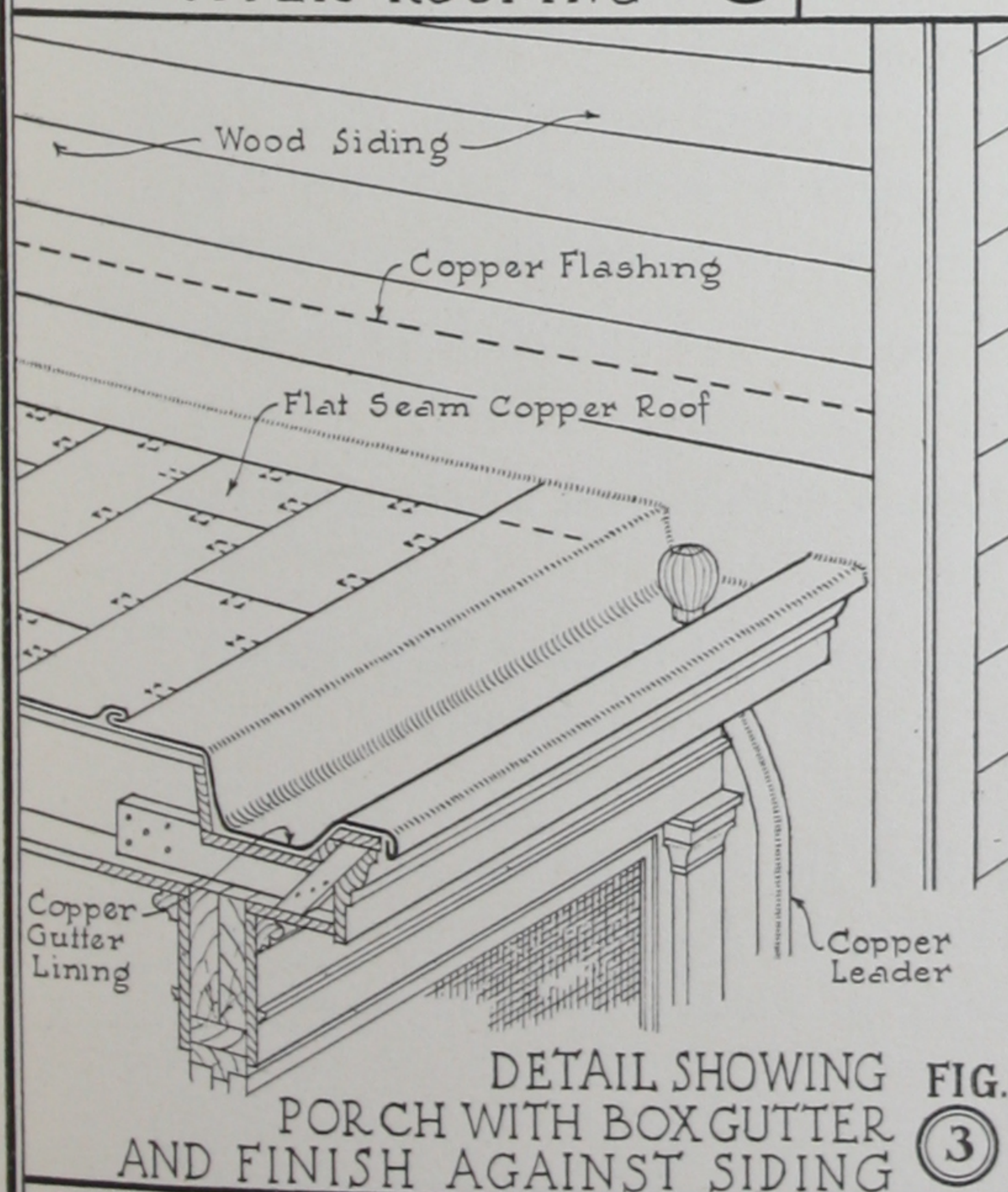
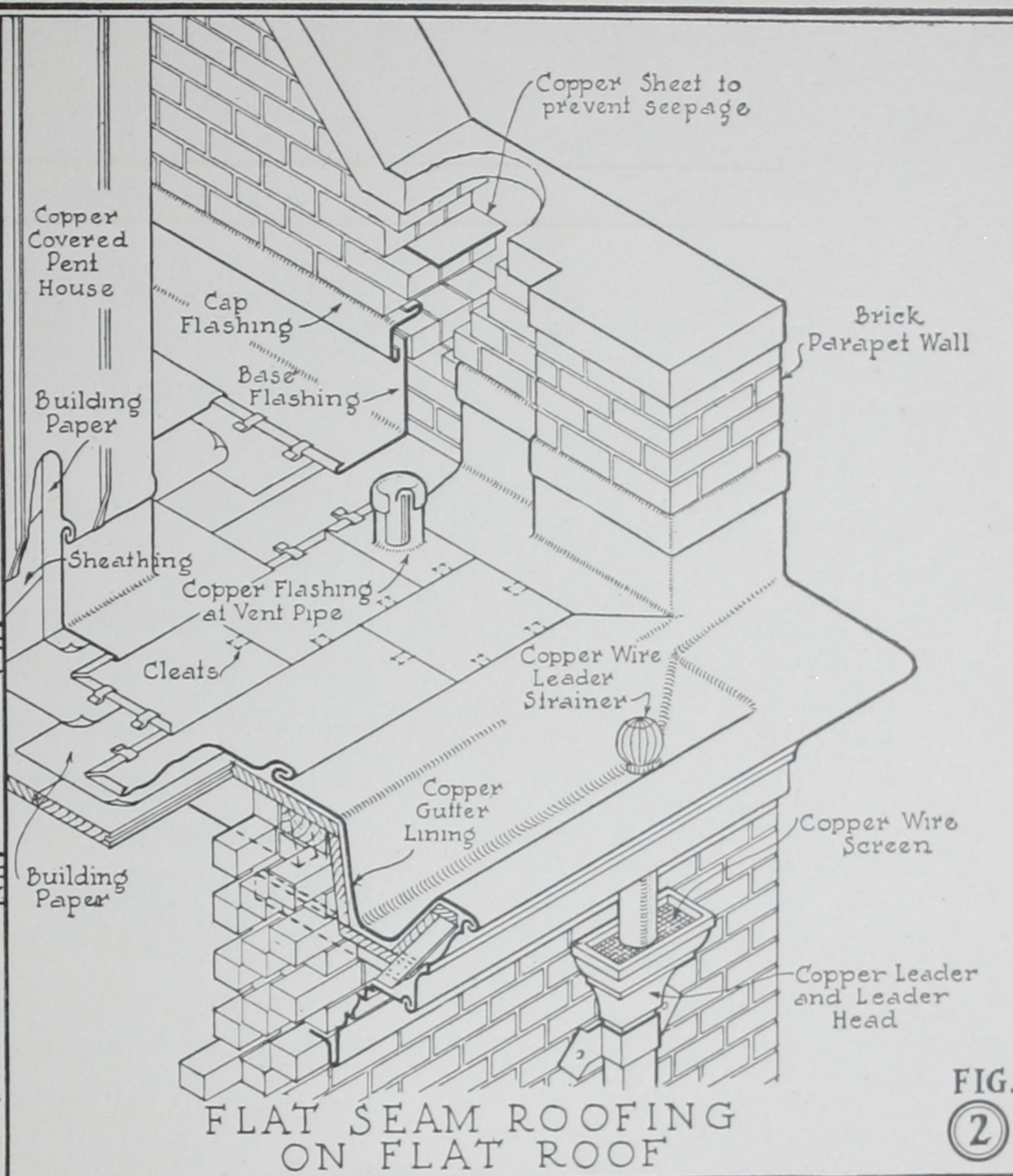
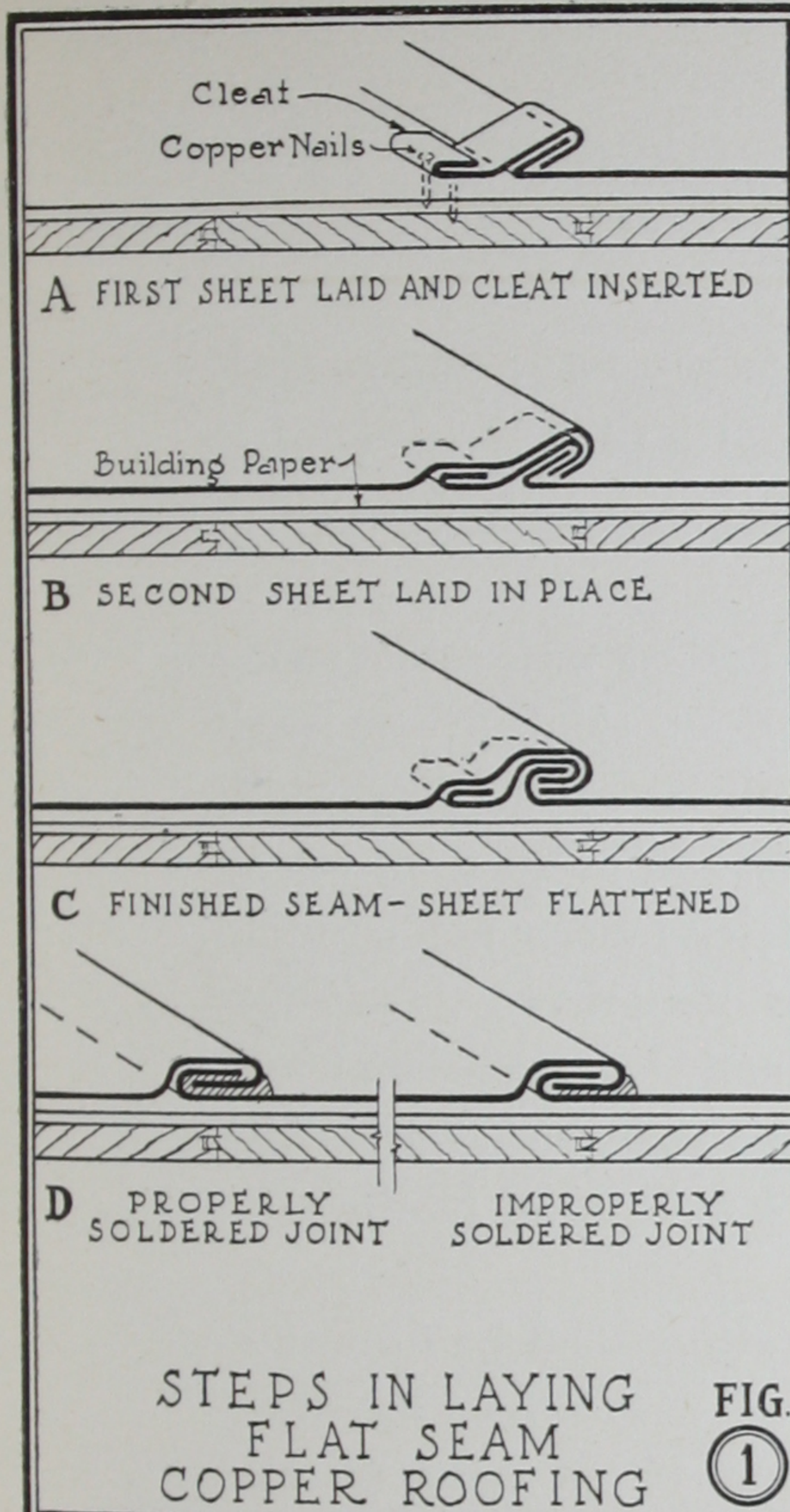
Step flashings shall be used where vertical surfaces occur in connection with pitched roofs. Steps shall lay not less than 3 inches.

Flashings around all shafts and skylights shall be extended up the full height of curbs and properly locked to eaves or gutters.

All pipes passing through the roof shall be flashed and counter-flashed with copper. Flashing shall extend out not less than 4 inches on the roof and shall be turned up not less than 8 inches against the pipes. The counter-flashing shall be caulked into hubs of pipes or embedded in elastic cement and held with brass clamps.

REGLETS

16. Where flashings occur against stone, reglets shall be cut in same by other contractor as required by this contractor. Cap flashings shall be turned into reglets not less than 1 inch and shall have an $\frac{1}{8}$ " or $\frac{1}{4}$ " bend on the edge.



NOTE ALL SEAMS HAVE BEEN EXAGGERATED TO SHOW CLEARLY METHOD OF LAYING.

The reglets shall then be filled with molten lead, on horizontal areas, and lead wool on vertical areas, flush with the face of the stone.

VALLEYS

17. All valleys shall be flashed with soft (roofing temper) copper. The sheets shall have no longitudinal seams and shall be of sufficient width and so cut as to increase in width from top to bottom. They shall extend under roof covering at least 6 inches and shall have their edges turned back $\frac{1}{2}$ inch, and shall be secured with cleats. On copper roofs valleys shall lock with copper sheets to form a water-tight joint.

MOULDED HANGING GUTTERS

18. Moulded hanging gutters shall be formed at the eaves of all roofs where shown on the drawings. They shall be of 16 oz. hard (cornice temper) copper and shall be of sizes indicated and constructed in strict accordance with the designs. They shall be secured by proper top braces of brass or copper spaced 30 inches apart.

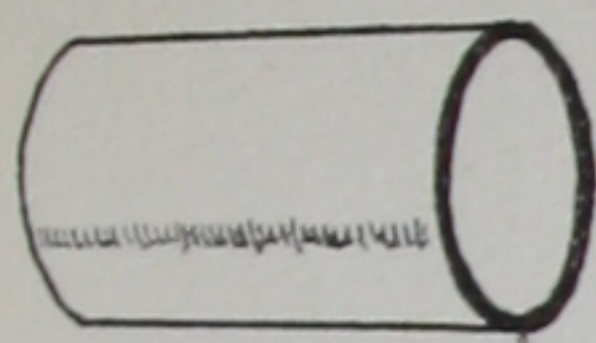
Joints shall lap one inch and shall be riveted and soldered.

On copper roofs gutters and sheets shall be locked together.

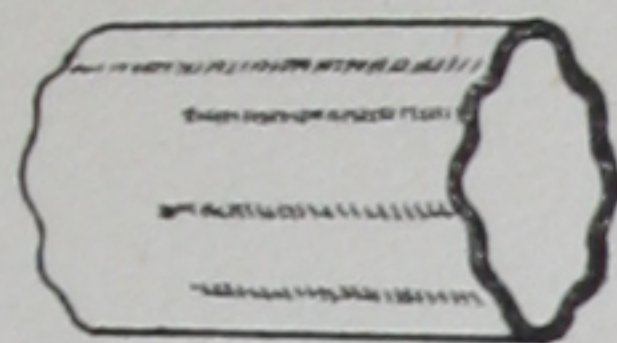
Gutters where noted, shall have inner linings of 16 oz. soft (roofing temper) copper.

EAVES TROUGHS

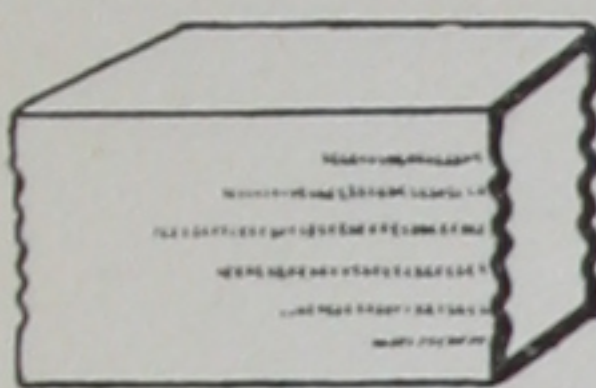
19. Where shown on the drawings hanging gutters shall be erected of hard (cornice temper) copper. The weight of metal shall be 16 oz. unless



ROUND (Plain)



ROUND (Corrugated)



SQUARE (Corrugated)



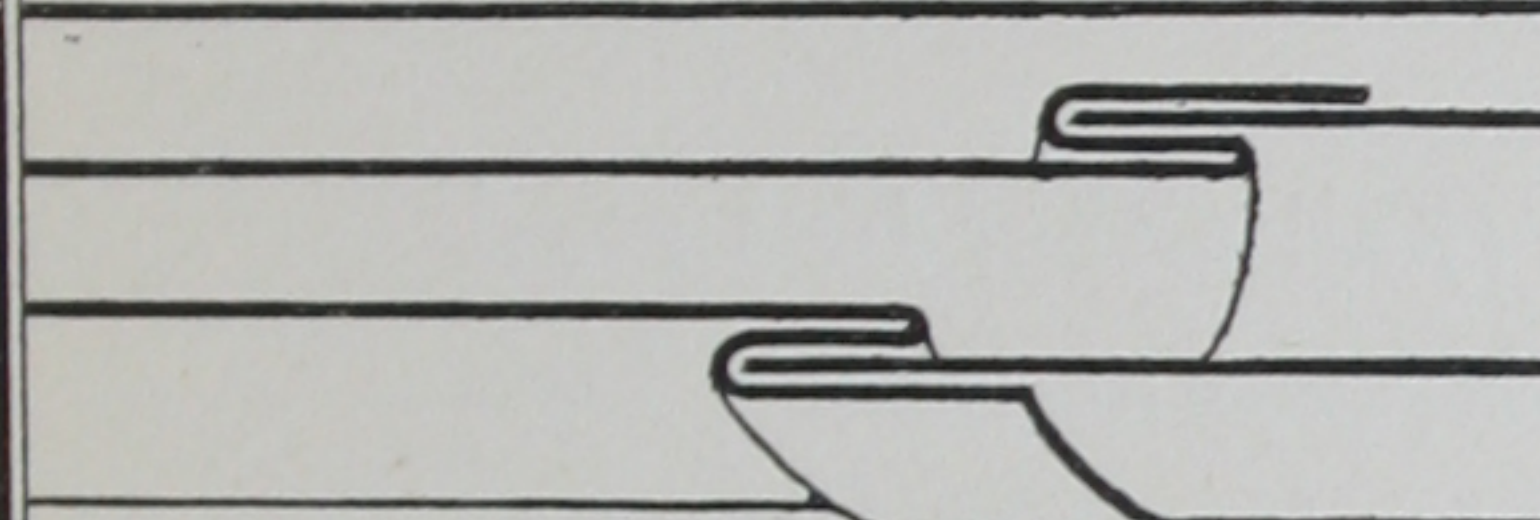
RECTANGULAR (Plain)

TABLE OF SIZES	
SHAPES	SIZES
ROUND (Plain)	2", 3", 4", 5", 6"
ROUND (Corr.)	2", 3", 4", 5", 6"
SQUARE (Corr.)	2" (1 3/4" x 2 1/4"), 3" (2 3/8" x 3 1/4") 4" (2 3/4" x 4 1/4"), 5" (3 3/4" x 5")
RECTANGULAR (Plain)	1 3/4" x 2 1/4", 2" x 3" 2" x 4", 3" x 4", 4" x 5", 4" x 6"

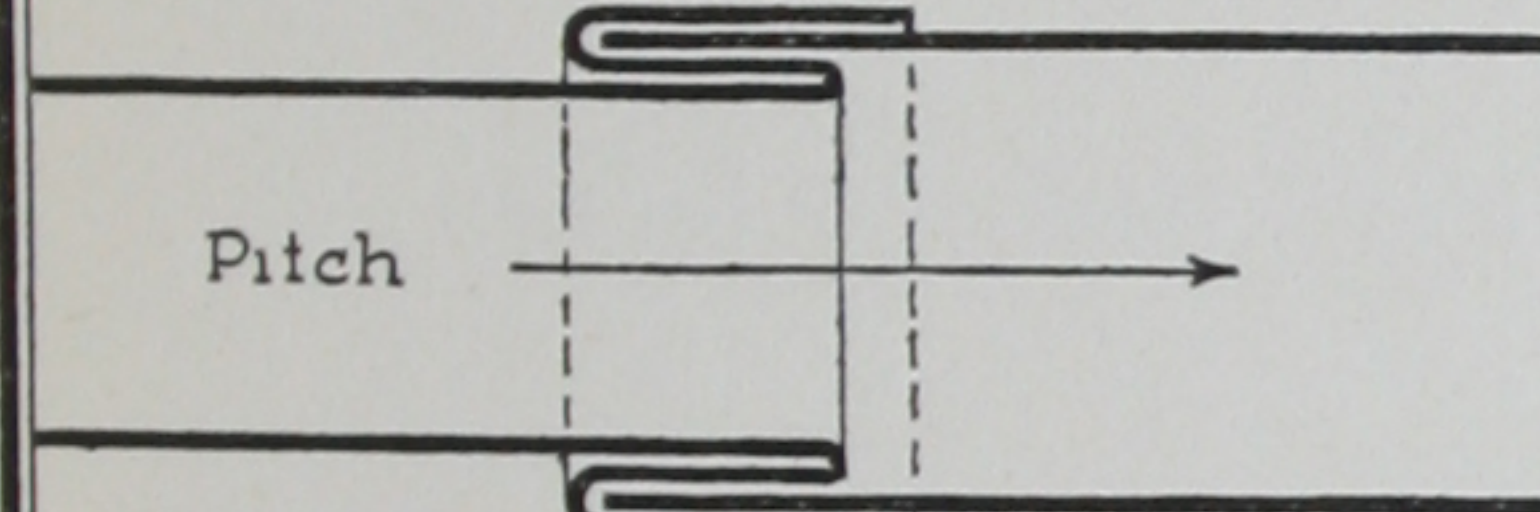
NOTE - These Leaders are made from hard (cornice temper) sheets.

FIG. 1

COPPER LEADERS



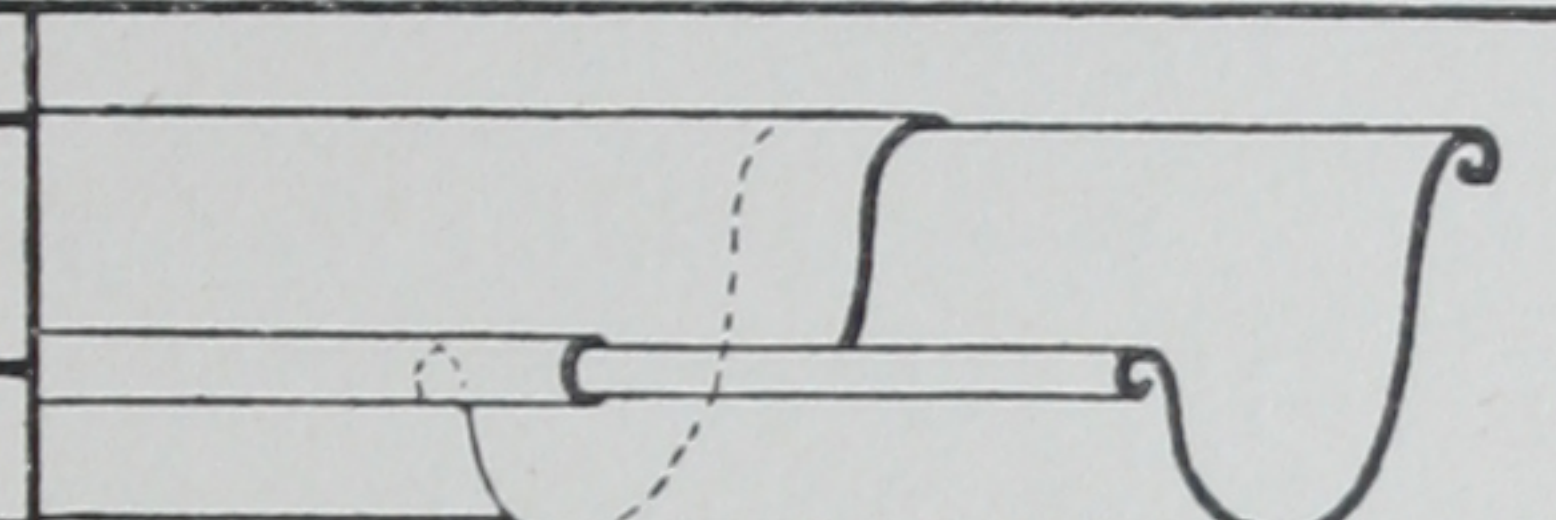
PERSPECTIVE VIEW OF JOINT



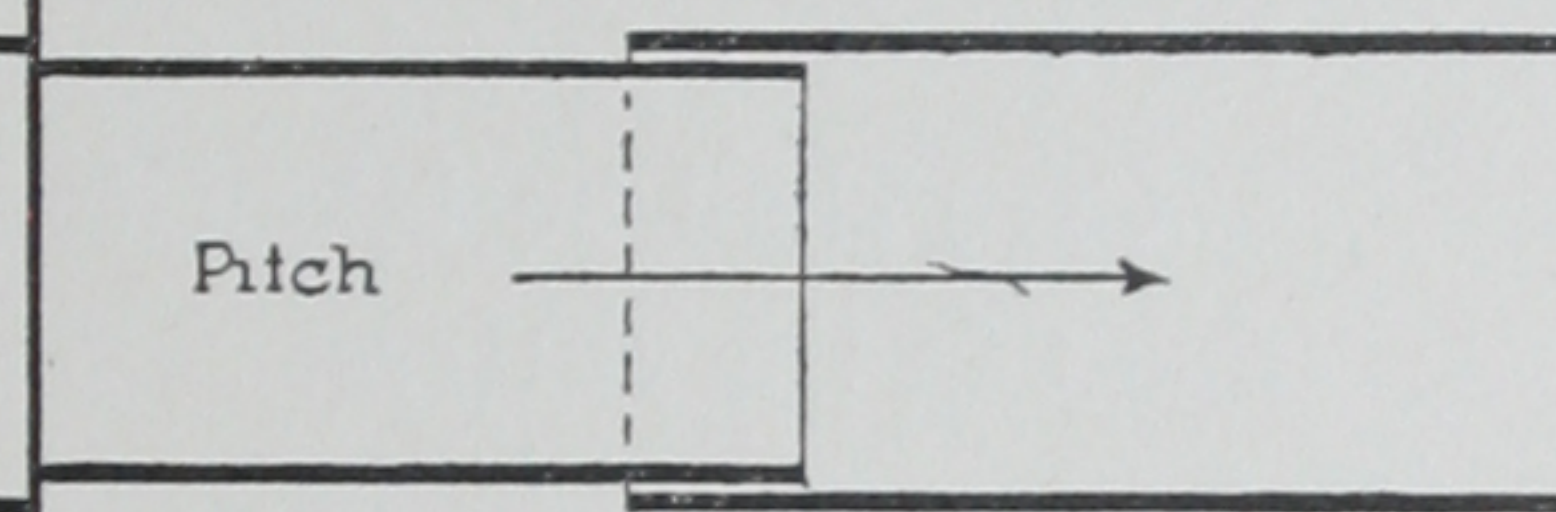
Pitch

PLAN OF JOINT BELOW BEAD

FIG. 2
DETAILS SHOWING EAVES TROUGH WITH SLIPJOINT



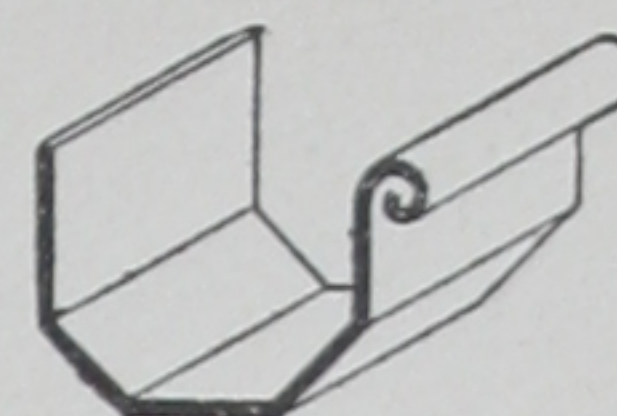
PERSPECTIVE VIEW OF JOINT



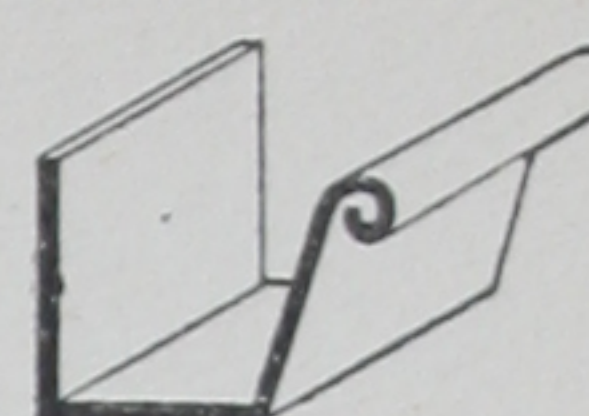
Pitch

PLAN OF JOINT BELOW BEAD

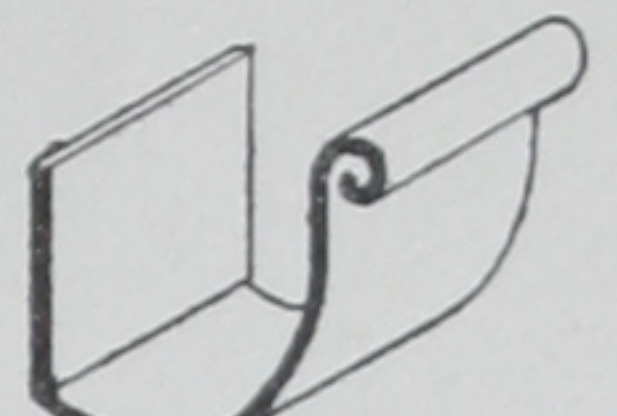
FIG. 3
DETAILS SHOWING EAVES TROUGH WITH LAP JOINT



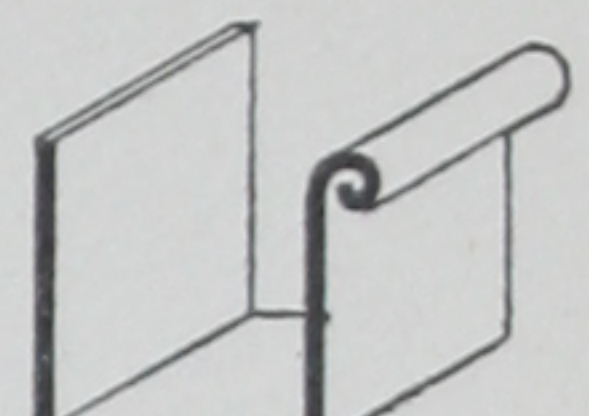
STYLE C.



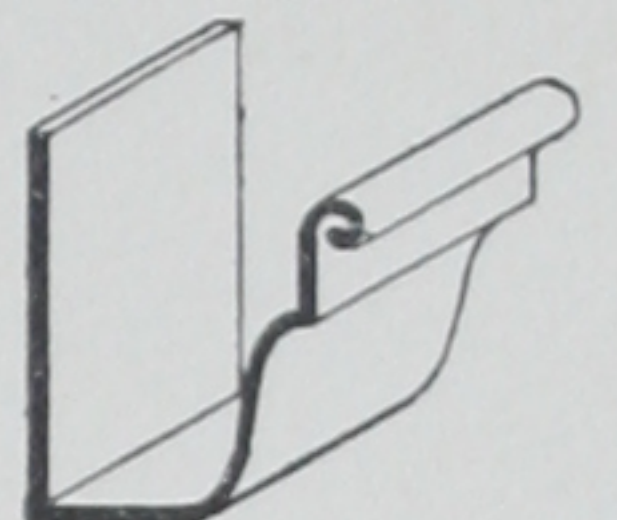
STYLE D.



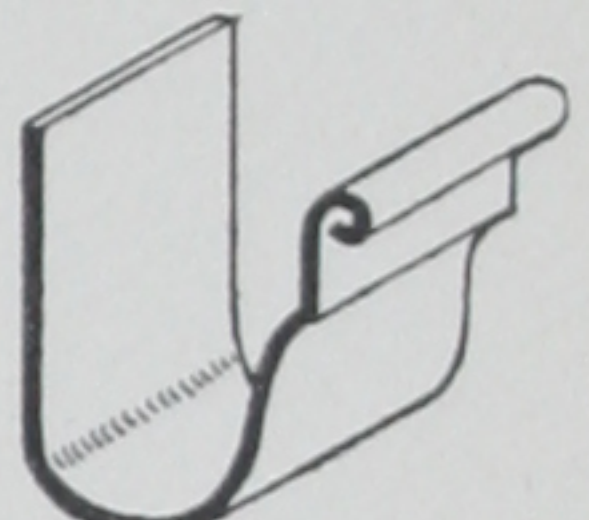
STYLE E.



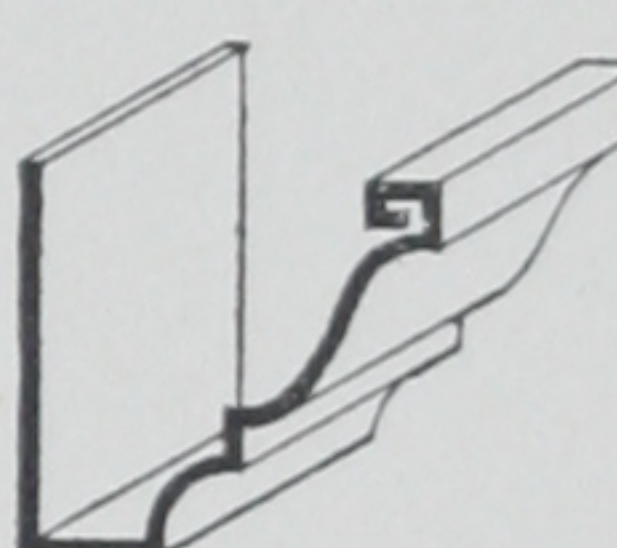
STYLE F.



STYLE G.



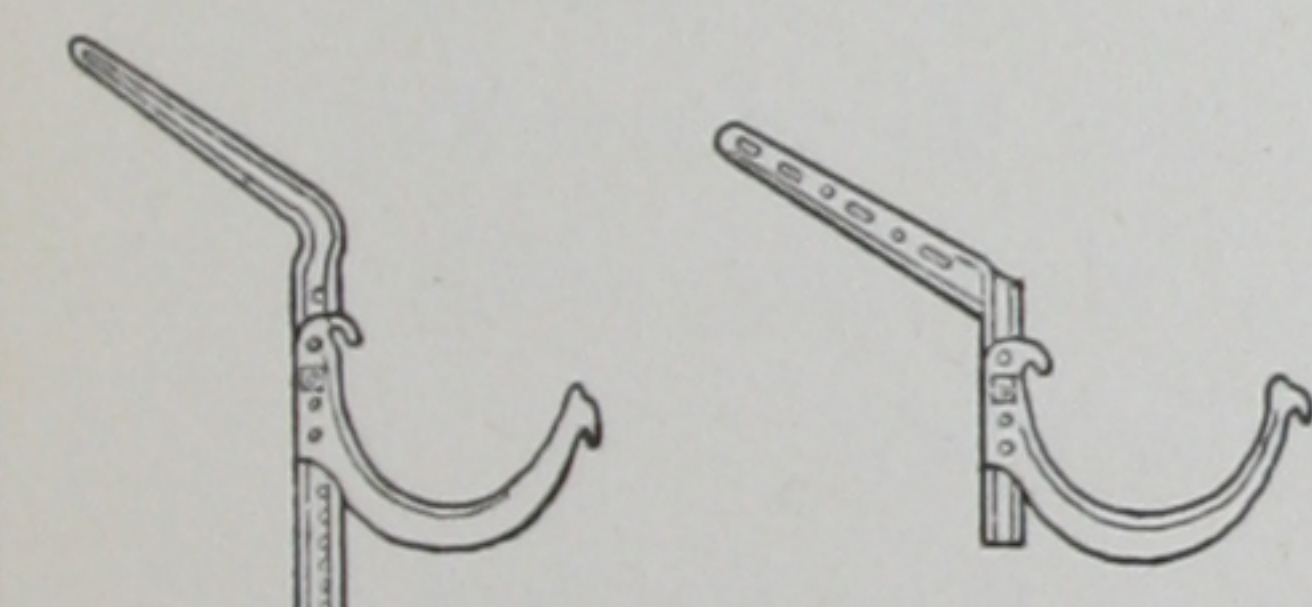
STYLE H.



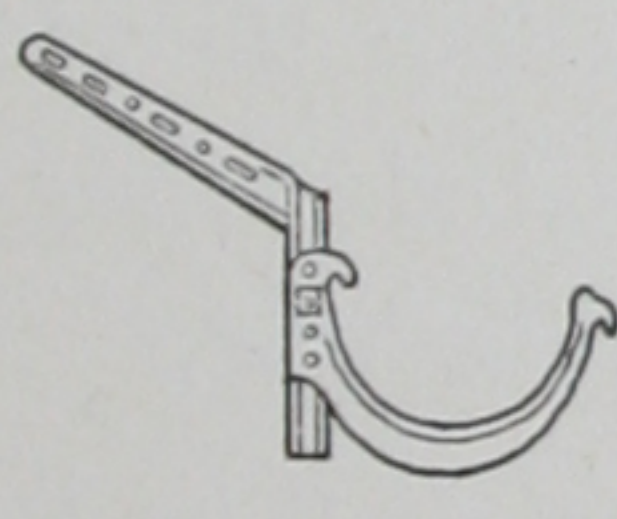
STYLE J.

NOTE - These gutters are made from hard (cornice temper) sheets.

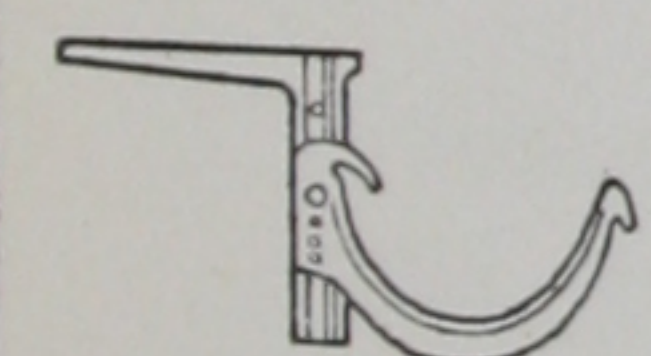
FIG. 4
MOULDED HANGING GUTTERS



SECURED UNDER SHINGLES



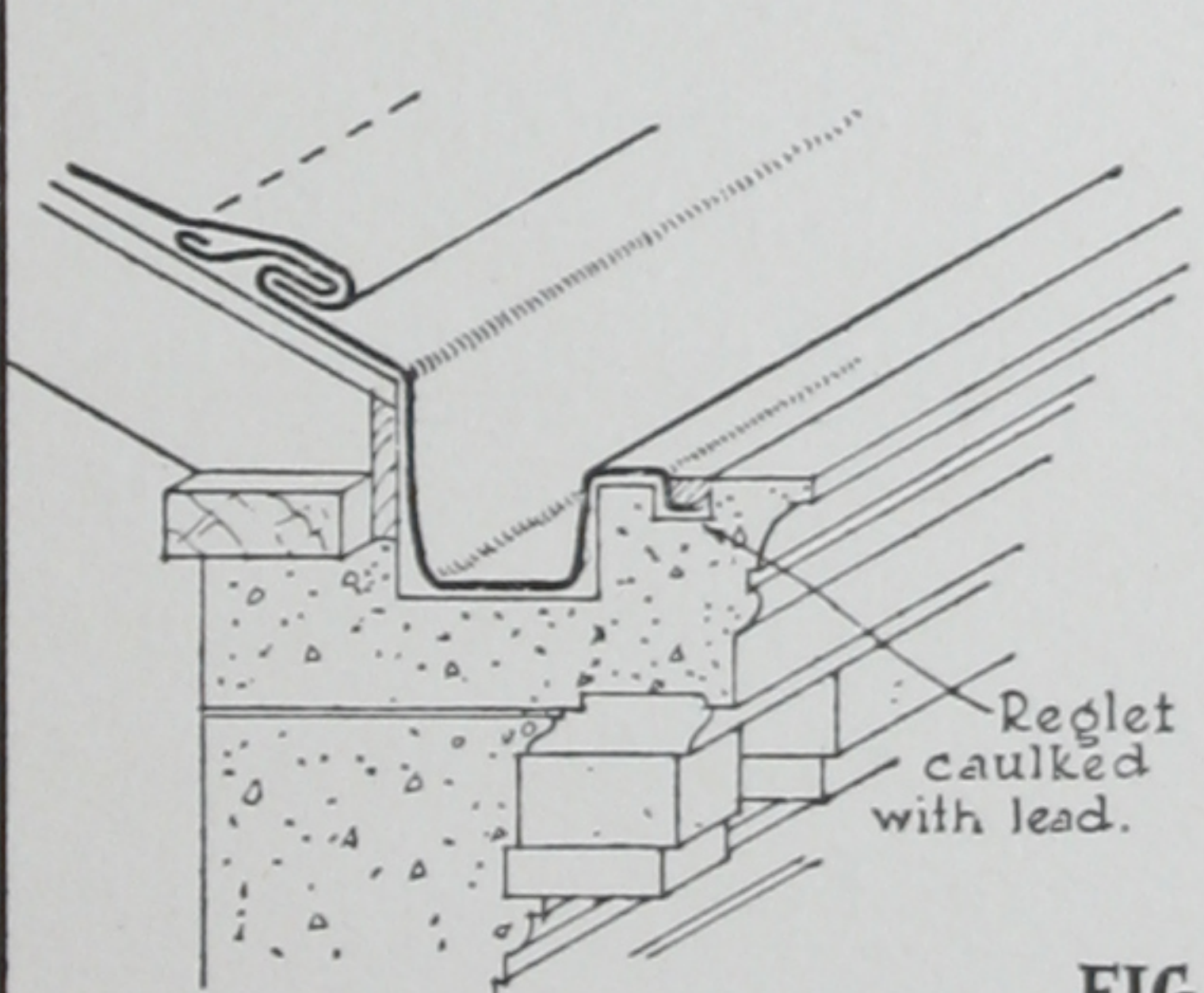
SECURED TO SIDE OF RAFTER



DRIVEN INTO BRICK JOINT
GUTTER HANGERS

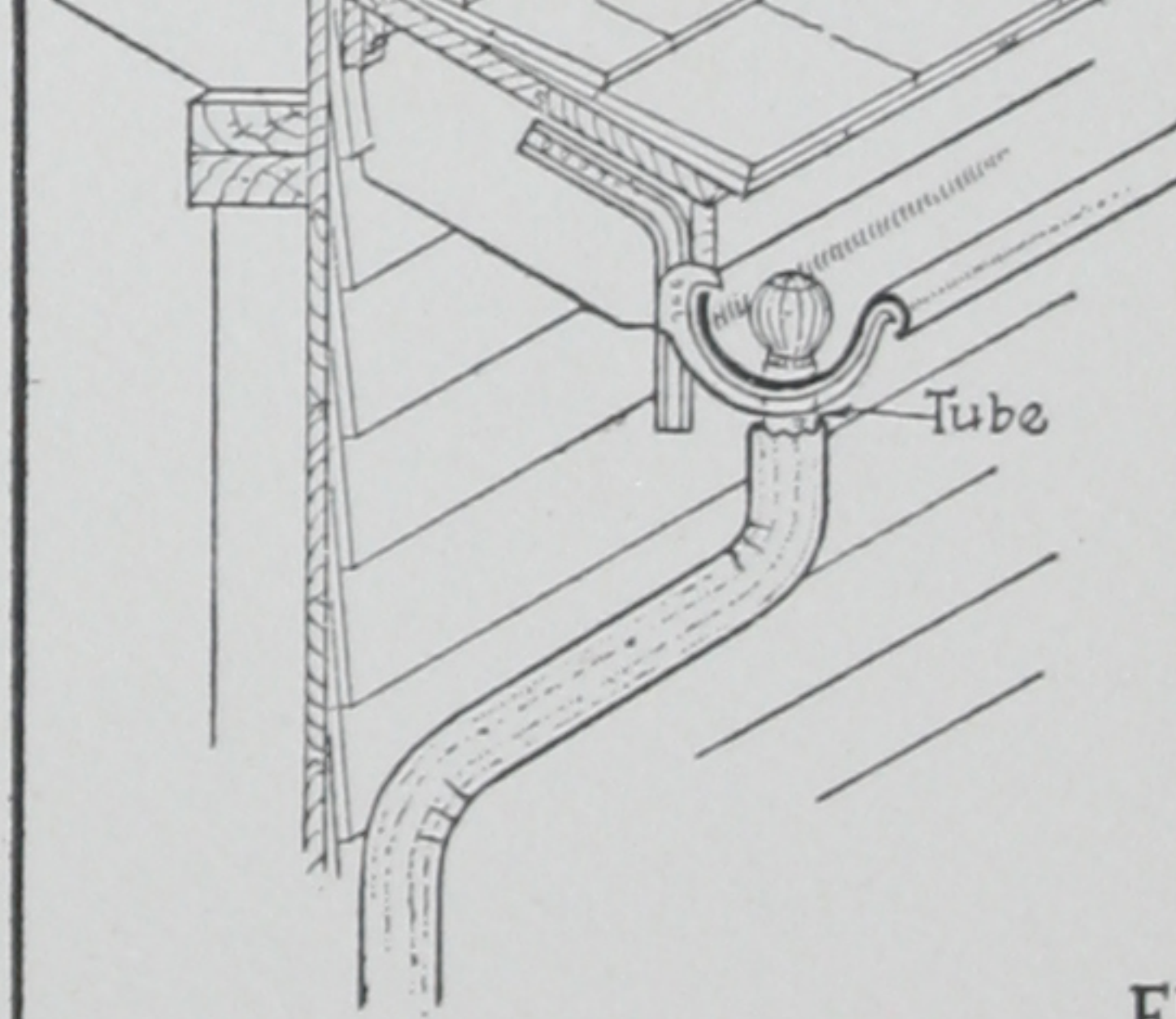
NOTE - These hangers should be of brass.

FIG. 5



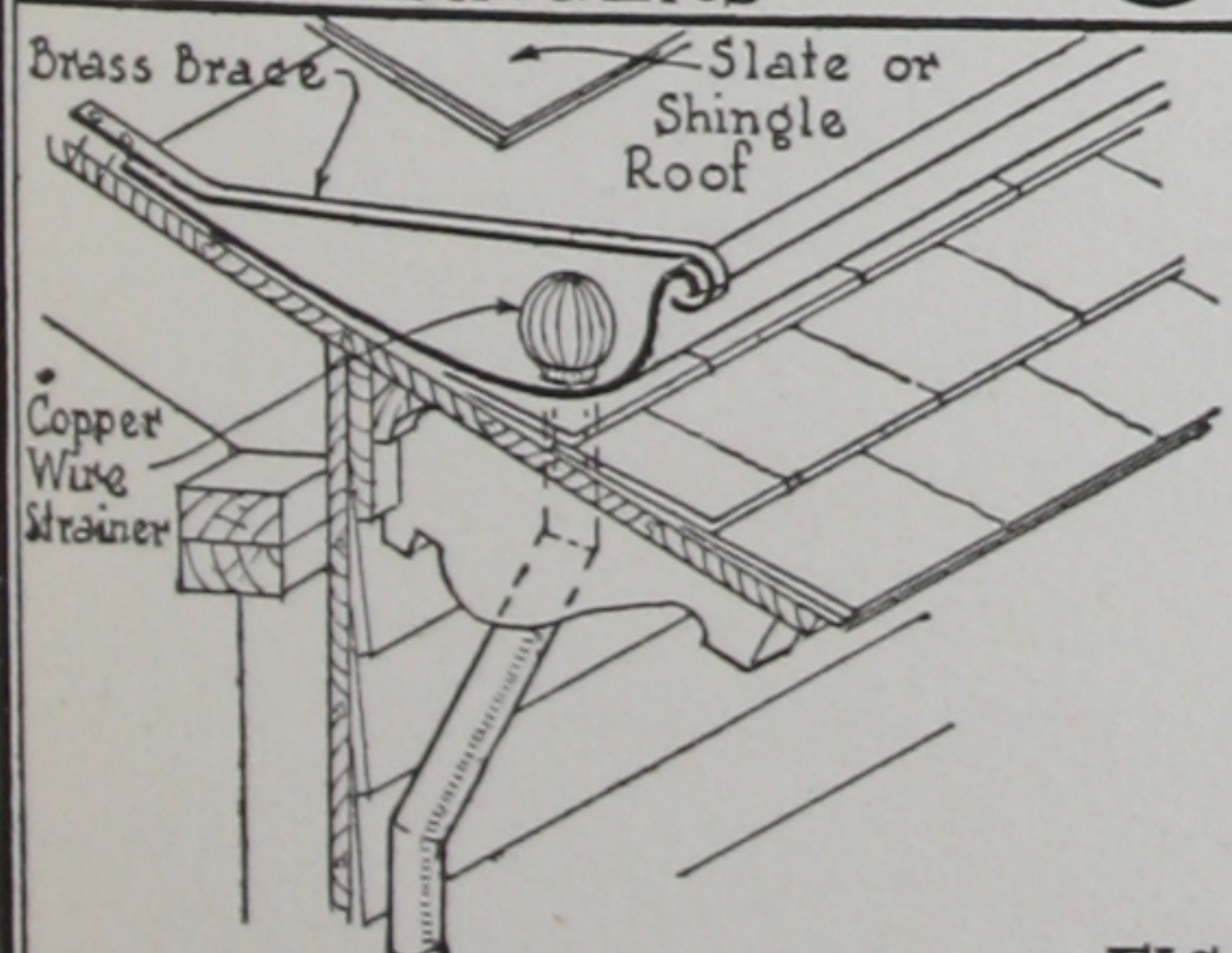
Reglet caulked with lead.

FIG. 6
COPPER GUTTER LINING SECURED TO REGLET IN CORNICE



Tube

FIG. 7
COPPER EAVES TROUGH AND LEADER



COPPER ROOF GUTTER AND LEADER

FIG. 8

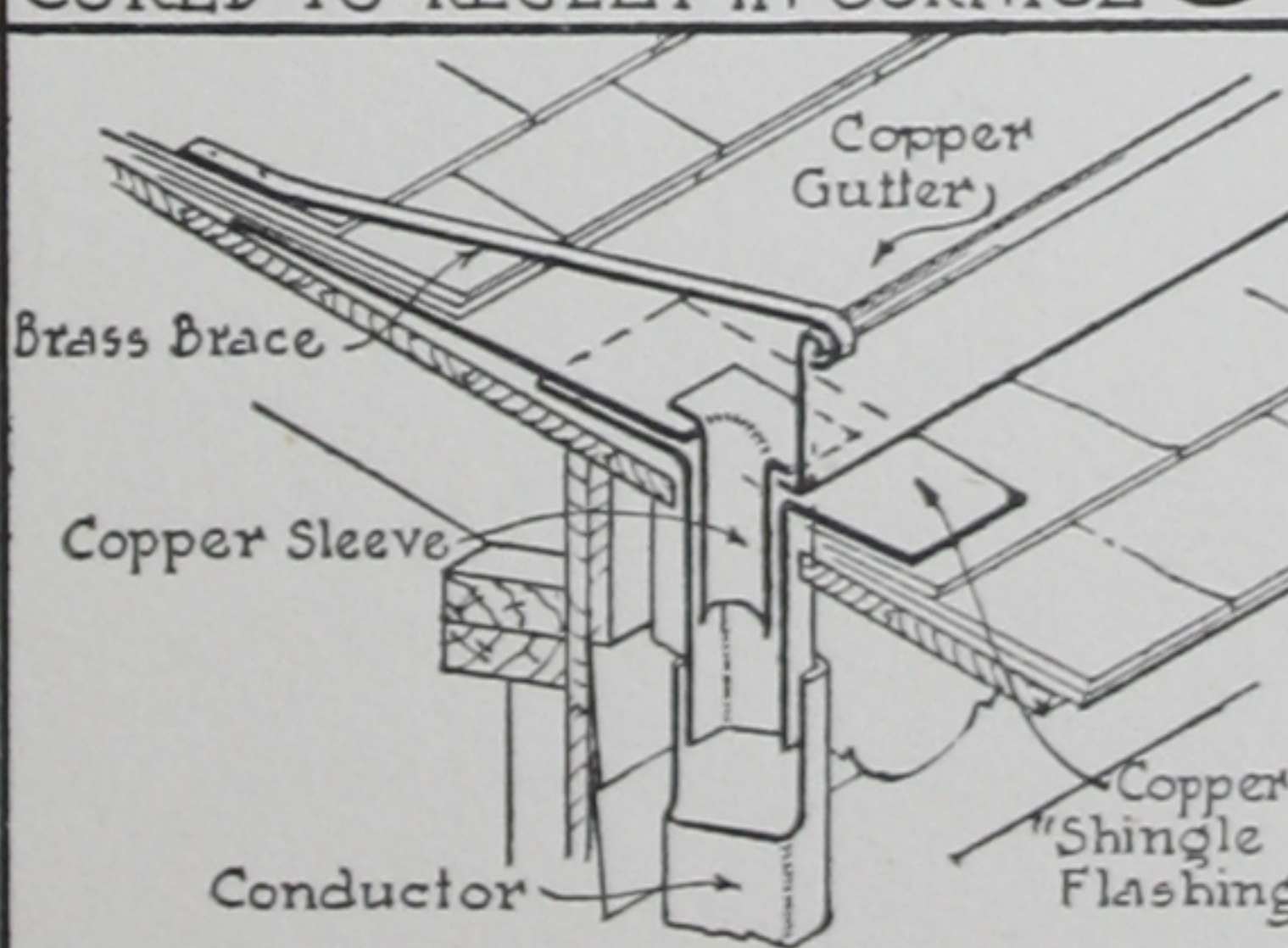


FIG. 9
METHOD OF MAKING A WATERTIGHT JOINT WITH LEADER

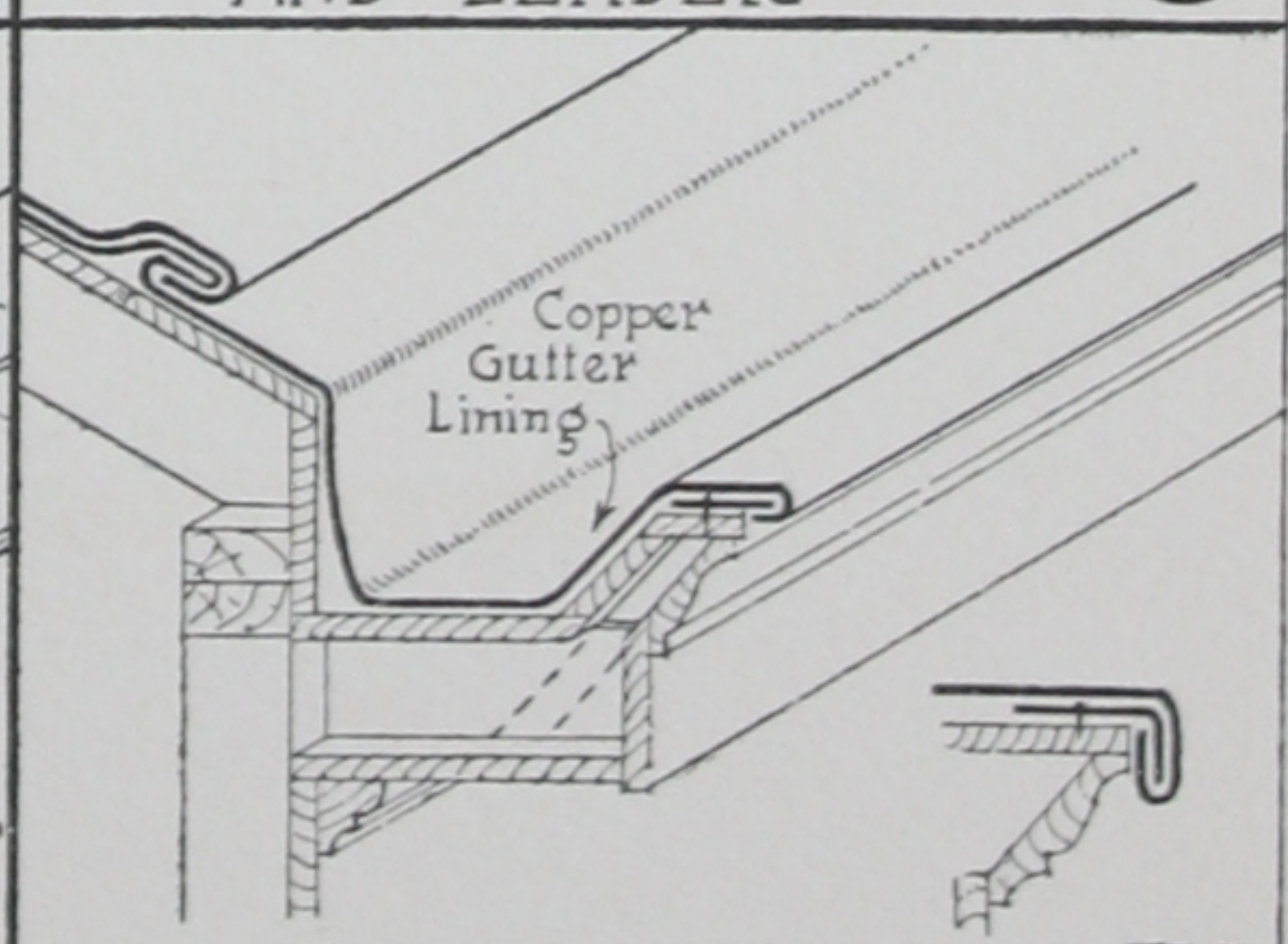


FIG. 10
COPPER LINED GUTTER WOOD CORNICE

otherwise noted. The shape shall be as shown on detailed drawings.

All gutters shall be secured to buildings by approved hangers of brass fastened by brass screws or bolts.

Ends of gutter sections shall either be tinned $1\frac{1}{2}$ inches on both sides, lapped at least 1 inch and well soldered, or have an approved type of slip joint.

Care shall be taken to allow room for movement in the gutters.

GUTTER LINING

20. All masonry gutter lining shall be of copper. The back edges of this lining shall be 3 inches higher than the front edges. Where the roofing is of copper it shall be connected thereto with locked joints. Where indicated lining shall carry up and finish under cap flashing.

The outer edge of the lining shall be finished into reglets as shown and specified above.

Care shall be taken to provide for expansion and contraction, and linings must fit loosely in the gutters.

All cross seams shall be tinned $1\frac{1}{2}$ inches wide on both sides and thoroughly sweated with solder. Laps shall be in the direction of drainage. Long gutters shall have ample provision for expansion and contraction.

STRAINERS

21. All outlets from roofs or gutters shall be

covered with an approved type of wire strainer made of No. 14 gauge copper wire.

LEADERS

22. Leaders shall be installed where and as shown on the drawings of hard (cornice temper) copper. They shall be of ample capacity.

All leaders shall be fitted with elbows where shown or as may be necessary.

When leaders are not connected to sewer, they shall be provided with heavy goosenecks or shoes at the bottom.

Leaders shall be held in position 1 inch clear of walls by approved fasteners of brass or copper. Not more than 20 feet of pipe shall be soldered in one length.

Laps for leaders shall be at least $1\frac{1}{4}$ inch and pipe shall be tinned on both sides. Slip joints shall be at least $1\frac{1}{2}$ inch and shall not be driven tight.

**TUBES AND
OUTLETS**

23. Where tubes are used to connect gutters to leaders a special flashing consisting of a "shingle flashing" with a sleeve soldered thereto shall be inserted in such manner as to be under the gutter and inside the leader so as to prevent any leakage around the joint made by the gutter and the outlet tube.

SKYLIGHTS

24. Copper skylights shall be furnished where shown on the drawings. They shall be constructed in a water-tight manner with joints

inter-locked, riveted and soldered and shall conform to the requirements of the National Board of Fire Underwriters. Ribs shall be formed with condensation gutters, reinforced as required and shall be provided with capping secured in place with brass bolts.

Detail drawings shall be submitted for approval.

CORNICES

25. All cornice work shall be of 16 to 20 oz. hard (cornice temper) copper accurately bent to the profiles shown on the detail drawings and reinforced with straps and angles as required. All plain surfaces shall be of crimped copper.

The ornament shall be stamped in soft (roofing temper) copper with dies made from approved models. Joints and seams shall be interlocked, riveted and soldered, reinforced on the back and made water-tight.

COPPER COVERED WALLS

26. On vertical walls marked "Copper" erect standing seam or paneled surfaces as indicated. This includes all bulkheads, skylight curbs, penthouse walls, etc. All standing seam work shall be fastened to wall surfaces with cleats nailed with copper nails to wood sheathing, or furring strips filled between with cement mortar. All paneled work shall have casings or strips to receive copper. All large panels or large area of plain surfaces shall be crimped.

SPECIAL INFORMATION

PITCH OF ROOFS

Pitch of roofs to be covered with flat seam copper roofing should not be less than $\frac{1}{2}$ inch nor more than 3 inches to the foot.

Pitch of ribbed and standing seam roofs should not be less than 2 inches, and preferably 4 to 6 inches, to the foot.

FINISH

Copper will develop verdigris in a few months due to natural phenomena. When it is desired to obtain a verdigris finish immediately, it can be done by the use of one of the following methods:

- (a) Dissolve 10 parts copper in $2\frac{1}{2}$ parts of strong nitric acid and then add 150 parts of 20% acetic acid and 5 parts of ammonia chloride. The resulting solution shall be diluted with about 3 parts water and applied to surface with a brush and allowed to dry. Sufficient applications at one or two day intervals shall be made until desired effect is produced.
- (b) Apply the following solution:
1 lb. of powdered sal ammoniac to 5 gals. of water; dissolve thoroughly and let stand 24 hours. Apply to copper with a brush, covering every part. Let stand one day and then sprinkle surface with clean water.
- (c) Use a solution of $\frac{1}{2}$ lb. of salt to 2 gals of water. Apply in same manner.

If a dark copper finish is desired it can be obtained by the following method: Rub off the copper with cotton waste soaked in boiled linseed oil. Touch up soldered seams with copper bronze.

